



LEGISLATIVE ASSEMBLY OF NEW SOUTH WALES

Legislative Assembly Committee on Investment, Industry and Regional Development

REPORT 1/56 – JUNE 2016

MANAGEMENT OF SHARKS IN NEW SOUTH WALES WATERS

REPORTS
COMMITTEES

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ASSEMBLY



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**LEGISLATIVE ASSEMBLY COMMITTEE ON
INVESTMENT, INDUSTRY AND REGIONAL
DEVELOPMENT**

MANAGEMENT OF SHARKS IN NEW SOUTH WALES WATERS

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The motto of the coat of arms for the state of New South Wales is “Orta recens quam pura nites”. It is written in Latin and means “newly risen, how brightly you shine”.

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Membership

CHAIR	Ms Melinda Pavey MP (From 20 June 2016) Mr Kevin Anderson MP (From 4 June 2015 to 2 June 2016)
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Terms of Reference

That the Committee inquire into and report on the management of sharks and the economic impact of shark attacks on communities in NSW, with particular reference to:

- a) The impact of shark attacks on tourism and related industries;
- b) Changes in shark numbers, behaviour or habitat;
- c) Adequacy of management strategies;
- d) Measures to prevent attacks by sharks, including strategies adopted in other jurisdictions; and
- e) Any other related matters.

Chair's Foreword

As the incoming Chair and Member of the Legislative Assembly Committee on Investment, Industry and Regional Development it is my pleasure to acknowledge the work by all Committee Members in the creation of this report.

I particularly acknowledge the contribution of the outgoing Chair, Kevin Anderson MP, who was instrumental in pursuing the issue at a time of great community concern following an unprecedented number of fatal shark incidents along the NSW coastline.

While there is a perception within the community that the number of sharks has increased, this is not supported by the scientific evidence. I welcome the Department of Primary Industries commitment to further our understanding of shark populations.

The report compiles in one document important scientific and historic information. It is a reference document that outlines Government strategies designed to address the management of sharks.

It also brings together evidence and information from shark experts and catalogues world leading technology. The Committee was particularly pleased to hear from scientist Dr Barry Bruce from the CSIRO who provided invaluable information about research into white shark populations and their movements.

The Department of Primary Industries has taken an important lead in monitoring shark populations and the introduction of new monitoring technology. They have also overseen the trial of more ecologically sound netting and other deterrents.

The inquiry heard the impact these harrowing shark incidents have had and continue to have on patrolling members as well as the general community, and of course the profound impact on survivors and families who have lost a loved one.

The 13 recommendations in this report present an opportunity for Government and the community to work together. Along with a better understanding of sharks, the report's recommendations seek to inform the community about beach safety, including awareness of sharks, and how beachgoers can make informed decisions when undertaking water based activities.

Anecdotal evidence suggests shark incidents can have an impact on local economies. It is clear that we need further information and research to better manage this issue.

As a surf lifesaving volunteer I'm particularly grateful for the contribution of Surf Life Saving NSW. Their ongoing efforts, through their volunteers, ensure continued water safety and shark monitoring at patrolled locations.

I thank the Legislative Assembly Committee staff for their contributions and support.



The Hon. Melinda Pavey MP
Chair

List of Findings and Recommendations

Recommendation 1	13
The Committee recommends that the Department of Primary Industries continue scientific research into shark behaviour to improve understanding of shark behaviour and population size.	
Recommendation 2	22
The Committee recommends that Destination NSW conduct research to determine the impact of shark attacks on tourism and related industries, using the recent spate of incidents on the NSW North Coast as a case study.	
Recommendation 3	33
The Committee recommends that the Department of Primary Industries commission an independent evaluation of its Shark Management Strategy no more than two years after commencement of the Strategy.	
Recommendation 4	33
The Committee recommends that the NSW Government consider augmentation of the Observation Tower Grant Program (including but not limited to the provision of extra funding) as a means of achieving better shark and water safety.	
Recommendation 5	33
The Committee recommends that the Department of Primary Industries consider trialling a shark spotters program where local conditions are appropriate.	
Recommendation 6	40
The Committee recommends that the Department of Primary Industries review the Shark Meshing (Bather Protection) Program every three years, to ensure that program is better able to adapt and incorporate innovations in technology and best practice.	
Recommendation 7	41
The Committee recommends that, subject to the outcome of current trials, the Department of Primary Industries move toward replacement of current shark meshing with more ecologically sustainable technologies such as the eco-barrier.	
Recommendation 8	48
The Committee recommends that the Department of Primary Industries develop an independent 'SharkSmart' website, with links to relevant websites including BeachSafe.org, the Department of Primary Industries, and the Water Safety Council.	
Recommendation 9	48
The Committee recommends that the Department of Justice ensure that the NSW Water Safety Council provides a link to the Department of Primary Industries SharkSmart information.	
Recommendation 10	48

The Committee recommends that Destination NSW provide links to Department of Primary Industries SharkSmart information on its Destination NSW and visitNSW websites.

Recommendation 11 _____ **49**

The Committee recommends that the Department of Primary Industries work with Surf Life Saving NSW (SLNSW) to distribute SharkSmart information through SLNSW's Coastal Accommodation Network.

Recommendation 12 _____ **49**

The Committee recommends that the Department of Primary Industries work with Surf Life Saving NSW, Surfing NSW, and all New South Wales coastal councils to ensure that SharkSmart information is provided on the websites of those organisations.

Recommendation 13 _____ **55**

The Committee recommends that the Department of Primary Industries monitor the outcomes of research and development of shark surveillance and deterrent technologies to identify technologies that could be implemented in New South Wales.

Chapter One – Introduction

- 1.1 In September 2014 a man died after being attacked by a shark at Byron Bay in NSW. In February 2015, Japanese surfer Tadashi Nakahara died after being attacked by a shark at Shelly Beach near Ballina. Two more men were injured in separate incidents in July 2015; one at Lighthouse Beach near Ballina, and the other at Evans Head. All of these incidents were widely reported in the media. By the end of 2015 there had been 14 incidents involving sharks in NSW waters, with eight people injured.
- 1.2 The number of incidents during 2015 represented a distinct ‘spike’ in incidents involving sharks in NSW. While the number of people injured or killed by sharks forms just a small proportion of all injuries or deaths arising resulting from water-based activities (such as drownings, or deaths from diving or boating accidents), the 2015 attacks nonetheless represented a significant increase on previous years. For example, in 2014 there were just three incidents involving sharks, following three in 2013 and five in 2012.¹
- 1.3 By August 2015, surfing-related businesses in Ballina, on the NSW North Coast, were reporting that their business had been affected by the attacks and associated media coverage.² The Committee met on 26 August 2015, and resolved to conduct an inquiry into the management of sharks in NSW, with a particular focus on the economic impact of shark attacks.

TERMS OF REFERENCE

- 1.4 On 26 August 2016, the Committee met and resolved to conduct an inquiry into the management of shark in New South Wales waters. Terms of reference for the inquiry were adopted, and these are detailed on page v.
- 1.5 The Committee resolved to advertise the inquiry via Isentia (a media monitoring service), with particular focus on coastal media outlets, inviting submissions by 23 October 2015. The Chair wrote to a number of potential stakeholders including government departments and agencies, science and research, surf and rescue organisations, and environmental groups, to invite them to make a submission. Fifty five potential stakeholders received a letter of invitation to make a submission.

CONDUCT OF THE INQUIRY

Submissions

- 1.6 The Committee received 81 submissions. These submissions came from a range of stakeholders, including individuals who live in the coastal regions and small business owners. Submissions also came from a number of organisations including the NSW Department of Primary Industries, local councils, research

¹ Australian Shark Attack File, <https://taronga.org.au/conservation/conservation-science-research/australian-shark-attack-file/>, Accessed 19 April 2016.

² <http://www.abc.net.au/news/2015-08-12/shark-attacks-close-calls-affecting-businesses-nsw-north-coast/6693080>, Accessed 19 April 2016.

INTRODUCTION

centres, environmental and conservation groups, and surf and rescue clubs. A full list of submissions is included at Appendix One.

- 1.7 The Committee resolved to publish most of the submissions it received, and these are available on the Committee's website at: <http://www.parliament.nsw.gov.au/investmentindustryandregionaldev>. Some submissions remained partially confidential, at the request of the author.

Visit of inspection

- 1.8 Members of the Committee travelled to Taronga Zoo and Sea Life Sydney Aquarium on Monday, 26 October 2015 to be briefed on the recent trends in shark attacks, and scientific research and findings. Mr Anderson, Mr Barr, and Ms Smith met with the following stakeholders:

- Ms Madeleine Smitham, Media Relations Officer, Taronga Zoo
- Mr Rodd Stapley, Coordinator of the Australian Shark Attack File, Taronga Zoo
- Dr Jo Day, Main Shark Researcher, Taronga Zoo
- Ms Claudette Rechterik, Executive Director, Sea Life Trust
- Mr Gerhard Beukes, Curator, Sydney Aquarium.

- 1.9 A full report on the site visit is available at Appendix Two.

Hearings

- 1.10 The Committee held the first public hearing at Ballina Lighthouse & Lismore Surf Lifesaving Club on Thursday, 26 November 2015. An informal hearing was conducted in the morning, followed by an informal meeting of stakeholders during the lunch break. The formal hearing was conducted in the afternoon.

- 1.11 The Committee held a second public hearing at Parliament House on Monday, 4 April 2016. A list of witnesses who appeared at each hearing is available at Appendix Three. Full transcripts for both hearings are also available on the Committee's website.

This report

- 1.12 The Committee had a particular interest in the impact of shark attacks on tourism, and any consequential impact on local economies. However, many of the submissions received focused on mitigation of the risk of shark attacks and the effects of different shark management strategies (particularly shark nets) on marine life. This report therefore considers both of these issues.
- 1.13 Chapter Two outlines the available knowledge about sharks and shark attacks in NSW waters. Shark attacks have been reported since the early years of white settlement, but in view of the number of people entering the water, remain a rare event.
- 1.14 Chapter Three considers the impact of shark attacks in 2014-2015 on tourism and related industries, particularly in the Ballina area. Ballina was the site of three separate incidents and was widely featured in the media coverage of shark

attacks. The Committee travelled to Ballina and met with people from the local community.

- 1.15 Chapter Four discusses current strategies used in NSW to manage the risk of shark attack. Shortly after the Committee commenced its Inquiry, the Hon. Niall Blair, Minister for Primary Industries, announced a new Shark Management Strategy. This chapter details the various initiatives involved in the Strategy, as well as canvassing other strategies proposed by Inquiry participants.
- 1.16 As already mentioned, the Committee received numerous submissions regarding the issue of shark nets or meshing, and Chapter Five discusses the use of shark nets in NSW. Inquiry participants were concerned about the impact of shark nets on marine life: these concerns related to both existing shark nets and the possible use of shark nets at additional sites. However, some Inquiry participants from the North and Mid North Coast proposed introduction of shark nets at beaches in those regions.
- 1.17 Chapter Six considers the information and education available to beachgoers. The Committee heard that it is extremely difficult - and probably impossible - to eliminate the risk of shark attack entirely. However, in addition to beach-level strategies, there are strategies that individuals can use to reduce their risk of being attacked. In order to maximise the effectiveness of these strategies, people need access to accurate, quality information.
- 1.18 Chapter Seven canvasses emerging new technologies which can reduce the risk of shark attack. While many of these strategies are in the trial or development stage, it is likely that some of them will emerge as key components of an effective shark strategy.

COMMITTEE COMMENT

- 1.19 The Committee thanks all those who participated in the Inquiry. NSW residents gave up their time to make submissions and/or attend public hearings, and the Committee appreciates the contribution that all participants made to this Inquiry.

Chapter Two – Sharks in New South Wales Waters

- 2.1 This chapter considers the current size of shark populations in New South Wales waters, particularly the white shark population. The chapter also considers why sharks attack humans, with a focus on the recent increase in attacks on the North Coast of New South Wales.

SHARKS IN NEW SOUTH WALES WATERS

- 2.2 There are more than 510 species of shark worldwide, with just over 180 of these sharks found in Australian waters. Most shark species do not pose a danger to humans.³ In New South Wales the main shark species identified as being responsible for unprovoked attacks on humans are the bull shark (*Carcharhinus leucas*), tiger shark (*Galeocerdo cuvier*) and white shark (*Carcharodon carcharias*).⁴
- 2.3 The shark most commonly implicated in attacks on humans is the white shark.⁵ Australia has two genetically distinct white shark populations: one population inhabits waters west of Bass Strait and the other lives in coastal waters off eastern Australia. There is limited movement between the two populations across the Bass Strait boundary.⁶
- 2.4 The number of sharks in NSW waters is not known. Globally, it is estimated that shark populations have declined substantially in recent decades due to a combination of factors such as commercial and recreation fishing, specific shark culling operations and changes to marine ecosystems.⁷ There is also some historical evidence to suggest that the white shark population has experienced a bigger decline than other shark populations.⁸
- 2.5 A number of shark species, including those in Australian waters, are now listed as vulnerable. For example, grey nurse sharks, which are not dangerous to humans, are critically endangered. White sharks have been listed as vulnerable since 1999. Their physiology and breeding characteristics mean they are slow to recover when their population is exploited and depleted: white sharks are long-lived and slow growing. They do not begin to reproduce until they are approximately five metres in length and 18-20 years of age.⁹ Adult females do not reproduce

³ Taronga Conservation Society Australia, Australian Shark Attack File, *Shark Know How*, Accessed 19 April 2016, www.taronga.org.au/animals-conservation/conservation-science/australian-shark-attack-file/shark-know-how

⁴ Submission 9, Marine Ecology Research Centre, School of Environment Science and Engineering, Southern Cross University, p3.

⁵ J. West, 'Changing patterns of shark attacks in Australian waters', *Marine and Freshwater Research*, 2011, p748.

⁶ Dr Barry Bruce, Senior Research Scientist, CSIRO, Transcript of evidence, 4 April 2016, p38.

⁷ Submission 79, Sea Life Trust, pp3-4.

⁸ Submission 9, Marine Ecology Research Centre, School of Environment Science and Engineering, Southern Cross University, p3.

⁹ CSIRO, *White shark research findings*, Accessed 20 April 2019, <http://www.csiro.au/en/Research/Environment/Oceans-and-coasts/Sharks/White-shark-research-findings>

annually and do not reproduce in large numbers. In addition, many of their young do not survive beyond their first year.¹⁰

- 2.6 While scientific understanding of shark physiology and behaviour is increasing, there is not as yet a reliable estimate of the size of the shark populations in Australian waters. One estimate of the population of white sharks in waters off eastern Australia puts the population at between 750 and 1200.¹¹ With no reliable historical catch data to use as a base, scientists are only now getting close to a position where they will have the means to reliably estimate the shark population, especially the white shark population.¹²
- 2.7 It has been established that the waters around the Port Stephens area – Stockton Beach north towards Seal Rocks – are a white shark nursery area. A large number of juvenile sharks, aged from around two to six years, are known to aggregate in the area on an annual basis for several months at a time.¹³
- 2.8 The reason the juvenile sharks aggregate in the waters around Port Stephens is unclear but scientists believe they may come to feed. Dr Barry Bruce, Senior Research Scientist with the CSIRO, advised the Committee that:
- We have some suspicions that in this particular place what they are doing is they are feeding on the coastal reefs and they are coming back into the surf zone to have a rest. So they are not feeding in the surf zone. They will obviously take bait. Sometimes it is very, very hard to get them to even look at bait. That could well be the reason we do not see those sorts of interactions here as the sharks may not be feeding.¹⁴
- 2.9 The selection of habitat by sharks appears to be influenced by a number of factors. These include the availability of food and environmental characteristics including salinity, water temperature, tide, depth and substrate type, as well as competition from other species.¹⁵
- 2.10 While there may be particular areas where sharks are known to prefer to hunt, their movements are wide-ranging.¹⁶ The results of the tagging program show that the pattern of shark movements up and down NSW coastal waters is irregular as it varies not only from season to season but also from year to year.¹⁷ Hence the presence of sharks in one particular area does not indicate an increase in the size of the shark population. Because sharks are so mobile, it is considered more likely that any increase in the number of sharks in one particular area means there are less sharks in other areas.¹⁸

¹⁰ Taronga Conservation Society Australia, Australian Shark Attack File, *Frequently Asked Questions*, Accessed 19 April 2016, <https://taronga.org.au/conservation/conservation-science-research/australian-shark-attack-file/faqs>

¹¹ Submission 46, No Shark Cull, p6.

¹² Dr Barry Bruce, Senior Research Scientist, CSIRO, Transcript of evidence, 4 April 2016, p42.

¹³ Dr Barry Bruce, 4 April 2016, p40.

¹⁴ Dr Barry Bruce, 4 April 2016, p40.

¹⁵ Submission 9, Marine Ecology Research Centre, School of Environment Science and Engineering, Southern Cross University, p4.

¹⁶ Submission 9, p3.

¹⁷ Dr Barry Bruce, 4 April 2016, pp39-40.

¹⁸ Submission 9, p3.

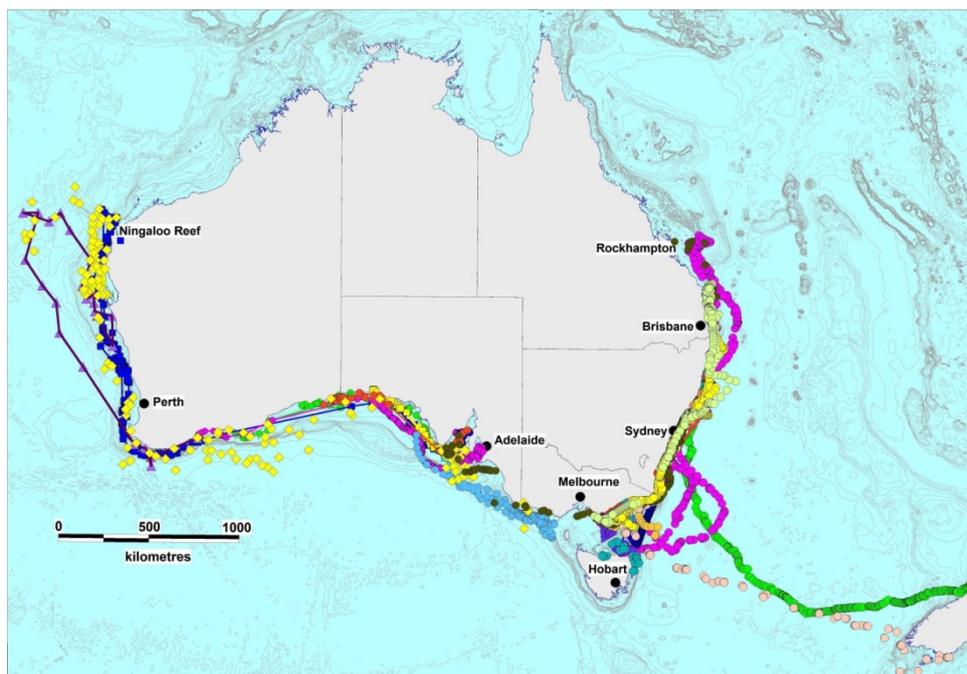


Figure 1: Movement patterns of white sharks

2.11 The presence of sharks in NSW waters is normal. As apex predators, they play an important role in maintaining a healthy marine ecosystem.¹⁹ Scientific studies show that the depletion of sharks results in the loss of commercially important fish and shellfish species further down the food chain, including key fisheries such as tuna that maintain the health of coral reefs.²⁰ For example, Sea Shepherd Australia provided examples of what can happen to a marine ecosystem when sharks are removed:

A 20-fold increase in cownose rays in North Atlanta for example, saw a collapse of a century old scallop industry as a result of 11 shark species being overfished. Additionally, in Jamaica, there has been a degradation of coral reefs to the point where microalgae now covers over 90% of the reefs as a direct result of overfishing a range of species, including sharks, which in turn allowed an increase in groper to graze on the herbivorous fish that would keep the algae at bay. In 1994, a report showed how coral abundance had declined in Jamaica from more than 50% in the 1970's to less than five per cent.²¹

Shark tagging program

2.12 The NSW Department of Primary Industries, in collaboration with the CSIRO, is currently conducting a shark tagging program. Many of the sharks are caught and tagged in the waters around Port Stephens.²² Tagging the sharks and recording their movements allows scientists to determine the biological and environmental factors that influence the movement of sharks along coastal waters. In the longer

¹⁹ Submission 9, p4.

²⁰ Sea Shepherd Australia, *Why are sharks important?*, Accessed 2 May 2016, <http://www.seashepherd.org.au/apex-harmony/overview/shark-importance.html>

²¹ Sea Shepherd Australia, *Why are sharks important?*, Accessed 2 May 2016

²² Dr Barry Bruce, 4 April 2016, p36.

term, understanding these factors will help in identifying areas where there is a potential risk to beachgoers.²³

- 2.13 Mr Scott Hansen, Director General, NSW Department of Primary Industries, explained that tagged sharks can be relocated away from swimming areas:

The shark tagging program as a whole really has two key benefits. The first one is the fact that we are catching, tagging and then relocating significant sharks away from a swimming area, a bathing area or surfing area. It has been shown in work done elsewhere—I think it was in Brazil—that relocation provides a significant reduction of risk to those swimming.²⁴

- 2.14 The tagging program involves attaching an acoustic tag and/or a satellite tag. Each acoustic tag has a unique number. This number is transmitted at regular intervals and detected by underwater receivers as the sharks swim past them. The receivers, located along the coast of NSW, record the date, time and identification code of the shark. The satellite tag transmits real-time updates, but only when the shark comes to the surface and has its fin out of the water for a sufficient amount of time. Time is needed to allow for the tag to activate and transmit to a satellite that is within range.²⁵

- 2.15 By October 2015 the Department of Primary Industries had tagged 14 sharks with both an acoustic and a satellite tag.²⁶ The Department has a target to tag a further 100 white, bull, and tiger sharks.²⁷ To date, the Department of Primary Industries and the CSIRO have tagged a total of 151 sharks – 80 bull sharks and 71 white sharks between them.²⁸

- 2.16 Twenty of the satellite linked (VR4G) shark listening stations will be deployed to provide real-time tracking data of tagged sharks. Ten of the listening stations are deployed in northern NSW waters. Another 10 will be deployed along the southern half of the NSW coastline for the summer of 2016/17. The receivers record the presence of tagged animals swimming within a 500 metre radius of the listening station and provide near real-time updates of tagged sharks close to key swimming/surfing locations.²⁹

- 2.17 The captured information is sent to the public and beach authorities via Twitter and the SharkSmart app (discussed later in this report). The Department of Primary Industries also manages several hundred VR2W listening stations. These must be retrieved from the seabed in order to download the captured data. This data provides scientists and researchers with finer scale information on shark

²³ Mr Scott Hansen, Director General, New South Wales Department of Primary Industries, Transcript of Evidence, 4 April 2016, p3.

²⁴ Mr Scott Hansen, 4 April 2016, p6.

²⁵ Dr Barry Bruce, 4 April 2016, p37.

²⁶ New South Wales Department of Primary Industries, *North Coast Local Waters Shark Tagging Project*, Accessed 18 April 2016, www.dpi.nsw.gov.au/content/fisheries/info/sharks/tips-to-reduce-your-risk-of-shark-attack/north-coast-shark-tracking

²⁷ Mr Scott Hansen, 4 April 2016, p6.

²⁸ Mr Scott Hansen, 4 April 2016, p6.

²⁹ New South Wales Department of Primary Industries, *Shark management: Shark Management Strategy*, Accessed 22 April 2016, <http://www.dpi.nsw.gov.au/fishing/sharks/shark-management>

movements and habitat. This information assists in understanding the factors that affect shark distribution and their interactions with humans.³⁰

- 2.18 Scientists also take a tissue sample from each shark as it is tagged. Analysis of each shark's DNA means scientists can genetically identify the parents of that individual shark. Identifying the parents of each tagged shark allows scientists to establish the proportion of white sharks that are related – the larger the proportion of unrelated white sharks; the larger the population is estimated to be. Dr Barry Bruce, Senior Researcher, CSIRO explained the process using the following analogy.

It is a bit like if you live in a country town and you walk down the street of that town there is a high likelihood you will run into somebody that you know because it is a small population. If you come from the country town into the centre of Sydney and you walk down George Street there is a high likelihood that you will not see anybody you know because the population is so much bigger. We can use the proportion of related animals that we find to estimate the population size in adults of white sharks. That is what we are working on at the moment.³¹

- 2.19 The CSIRO is currently working to finalise estimates of the east coast population of white sharks. This work will tie in with other scientific research to monitor trends in population and establish the abundance of white sharks and if the population is increasing or decreasing.³²

SHARK ENCOUNTERS

- 2.20 According to the Australian Shark Attack File, there have been 213 unprovoked shark attacks in NSW over the last 100 years. This figure includes 48 fatalities and 112 people injured.³³ The Australian Shark Attack File is maintained by the Taronga Park Zoo. While figures from earlier years were compiled from a range of sources, data compiled since the establishment of the Shark Attack File in 1984 is accurate to a high degree.
- 2.21 The majority of human interactions with sharks occur in near-shore coastal waters. According to the Australian Shark Attack File, the largest proportion of incidents occur while people are surfing (42 per cent), swimming (21 per cent), or diving (14 per cent).³⁴
- 2.22 Surfers usually encounter sharks on the seaward side of the waves near deeper water where sharks can approach without being observed. Swimmers usually encounter sharks inshore of a sandbar or near drop offs to deeper water. The majority of shark attack victims do not see the shark until the shark has made contact with them, either by nudging or biting them or their surfboard.³⁵

³⁰ New South Wales Department of Primary Industries, *Shark management: Shark Management Strategy*, Accessed 22 April 2016, <http://www.dpi.nsw.gov.au/fishing/sharks/shark-management>

³¹ Dr Barry Bruce, 4 April 2016, p42.

³² Dr Barry Bruce, 4 April 2016, pp36&42.

³³ Taronga Conservation Society Australia, Australian Shark Attack File, *Latest Figures*, Accessed 20 April 2016, <https://taronga.org.au/animals-conservation/conservation-science/australian-shark-attack-file/latest-figures>

³⁴ J. West, 'Changing patterns of shark attacks in Australian waters', *Marine and Freshwater Research*, 2011, p748.

³⁵ Taronga Conservation Society Australia, Australian Shark Attack File, *Shark Know How*, Accessed 4 May 2016,

- 2.23 While the number of people injured or killed by sharks is small, community fear and anxiety about sharks is heightened, not just within the local community where the attack occurred but across the broader community. Media reporting of shark attacks can also heighten community fear and spread misinformation about sharks.
- 2.24 The reason why sharks occasionally attack humans is not known, and it is likely that there is no single factor that explains all incidents. Indeed, Dr Barry Bruce from the CSIRO suggested that scientists may never fully understand what provokes a shark to attack.³⁶
- 2.25 Numerous theories have been proposed to explain shark attacks. As the Sea Life Trust pointed out, many of these theories are not supported by scientific evidence.³⁷ Some examples include:
- Sharks target people for food – if true there would be more attacks and people would be consumed by the shark, most shark attack victims receive one bite
 - Sharks are attracted to human blood – sharks have evolved to detect fish blood and tests show that sharks show little reaction to the presence of human blood
 - Sharks are attracted to certain colours – sharks are actually colour-blind and are attracted to high colour contrasts such as white on black
 - Sharks are defending their territory – sharks are not known to display territorial behaviour or aggressively defend an area as their own
 - Sharks are hungry due to overfishing – large sharks travel great distances to find food and feed infrequently
 - Sharks will eat anything – it is likely that metal objects that have been found in the stomachs of some sharks were consumed because the shark was confused by the electromagnetic field emitted by the object, or objects such as rocks were swallowed accidentally while feeding.
 - Shark populations have increased – all available scientific evidence indicates that most shark populations have declined, and
 - A ‘rogue shark’ will repeatedly attack humans once it has acquired a taste for human blood it will repeatedly attack humans.³⁸
- 2.26 However, there are a number of other theories that are supported to some extent by scientific evidence. The following theories are being investigated by scientists:

<https://taronga.org.au/animals-conservation/conservation-science/australian-shark-attack-file/shark-know-how>

³⁶ Dr Barry Bruce, 4 April 2016, p41.

³⁷ Submission 79, Sea Life Trust, pp6-7.

³⁸ Submission 79, pp6-7.

SHARKS IN NEW SOUTH WALES WATERS

- Sharks may mistake humans as prey – the silhouette of a surfer on a board may resemble a seal or a turtle when viewed from below
- Sharks are inquisitive – they bite an object as a means of trying to identify it
- Low frequency sounds may attract sharks and they may approach to further examine objects
- Sharks may try to bite boat motors or shark cages as the metal in boat motors generates an electromagnetic field that can attract sharks – the shark is not trying to attack the people on the boat or in the cage
- Sharks may be warning or defending themselves if they perceive a human to be a threat – a shark bite could be a defensive reaction as sharks sometimes bump, tail slap or briefly bite each other to protect personal space, or as a display of dominance.³⁹

2.27 The difficulty in being able to reliably predict shark behaviour is due to the fact that there is no one type of shark behaviour. Sharks do not feed all of the time and, as a result, their behaviour is not always driven by their need to feed. Sharks are known to spend a large amount of time not engaging in any activity as they swim up and down coastal waters.⁴⁰

2.28 Sharks also exhibit different behaviour depending on the type of prey they are hunting. For example, sharks exhibit different behaviour when they are hunting seals around a seal colony than when they are hunting salmon, mullet or rays along a beach or reef.⁴¹

2.29 Through the shark tagging program, scientists have established that the Australian east coast population of white sharks is continually moving between Bass Strait in the south and along NSW coastal waters, travelling as far north as the southern end of the Great Barrier Reef, and across the Tasman Sea to New Zealand.⁴² However, available evidence suggests that the movements of adult sharks are driven primarily by the availability of their food source, which includes fish, seals, whales, crustaceans and other sharks. Water temperature also plays a role.⁴³

2.30 Several Inquiry participants suggested that one possible explanation for an increase in shark attacks is the increased number of people engaging in water based activities. The Australian Shark Attack File also notes that, as a general trend, this is the single most important variable in explaining increasing numbers of shark attacks.⁴⁴

³⁹ Submission 79, Sea Life Trust, p7.

⁴⁰ Dr Barry Bruce, 4 April 2016, p42.

⁴¹ Dr Barry Bruce, 4 April 2016, pp42-43.

⁴² Dr Barry Bruce, 4 April 2016, p38.

⁴³ Submission 9, p3.

⁴⁴ J. West, 'Changing patterns of shark attacks in Australian waters', *Marine and Freshwater Research*, 2011, p744.

- 2.31 However, the increase in people engaging in water-based activities does not account for clusters or spikes in shark incidents. Dr Bruce argued that linking numbers of people in the water to increases in shark attacks is too simplistic:

It is very important to be mindful of timeframes when you make those sorts of statements. Changes to the numbers of people in the water cannot explain a sudden spike or cluster in shark attacks; that is quite silly. However, over periods of decades where you see an increase in the number of shark attack incidents along our coastline then that is where those statements about numbers of people in the water will come into play.⁴⁵

- 2.32 The Committee also heard that the presence of sharks alone is not an indicator of the immediate risk of attack.⁴⁶ For example, the waters around Port Stephens are known to be nursery area for juvenile white sharks – sharks less than three metres in length – and the area is also popular with beachgoers. However, the area is not regarded as being high risk for shark attack.⁴⁷ There are two surf lifesaving clubs in the area of the shark nursery, and these clubs regularly close their patrolled beaches due to the presence of white sharks. However, there has never been an attack at these beaches.⁴⁸

- 2.33 Dr Bruce observed that the evidence from the Port Stephens area indicates that that there is no simple relationship can be drawn between the shark population and the incidence of shark attacks on humans:

... if you were going to use the number of shark attacks as a proxy to estimate the numbers of sharks in the environment then you would come up with the conclusion that there were no sharks here, yet there are a lot of them.⁴⁹

RECENT INCREASE IN SHARK ENCOUNTERS ON THE NORTH COAST

- 2.34 It is not yet possible to establish whether the cluster of attacks on the North Coast during 2014-2015 represents a continuing trend.⁵⁰ Dr Geoffrey Allan, Deputy Director General, Department of Primary Industries, described the recent incidents as a 'spike' in shark attacks.⁵¹ Available evidence indicates that shark attacks do sometimes occur in 'clusters' or 'spikes'. For example, No Shark Cull detailed instances when similar clusters have occurred in several locations around the world:

... New Zealand from 1964-68, Brazil from 1992-2006, there was a spate in Hong Kong in the early 90's and in Cape Town South Africa at the same time in Hawaii in 1991-92 and Western Australia from 2011-2013. Shark bites sometimes occur in clusters and when this occurs the media typically report these events in

⁴⁵ Dr Barry Bruce, 4 April 2016, p41.

⁴⁶ Dr Barry Bruce, 4 April 2016, p40&44.

⁴⁷ Submission 9, p3.

⁴⁸ Dr Barry Bruce, 4 April 2016, p40.

⁴⁹ Dr Barry Bruce, 4 April 2016, p40.

⁵⁰ Dr Geoffrey Allan, Deputy Director General, New South Wales Department of Primary Industries, Transcript of evidence, 4 April 2016, p2.

⁵¹ Dr Geoffrey Allan, 4 April 2016, p2.

sensationalist terms that have the resultant impact on the emotional state of people living in these areas.⁵²

2.35 Without a comprehensive understanding of shark behaviour, it is not possible to conclusively account for the recent increase in shark attacks on the North Coast. While shark behaviour is not completely understood, what is known is that sharks follow and hunt potential prey.⁵³ The Marine Ecology Research Centre at Southern Cross University reported that there was an observable increase in the abundance of fish along the North Coast during 2014-15. They considered that 'Abundance of schools of fish on the North Coast over the past few months is likely to be one of the most important factors in juvenile white shark concentration.'⁵⁴

2.36 As previously discussed, the results of shark tagging program have shown that sharks are present in the waters around Ballina at any time of the year and that this is typical shark behaviour.⁵⁵ Analysis of sharks' wide ranging movement patterns shows they have locations they regularly visit, and any increase in the availability of fish is likely to attract them. The Marine Ecology Research Centre explained that the risk sharks post to humans is usually low:

... in any ecosystem, such large predators are rare because each requires an extensive food web to provide sustenance in a large enough form to be energetically worth the effort of catching, and the risk is therefore relatively small. However, in places where food resources become particularly abundant, such as where fish aggregate to spawn or around river mouths after heavy rain, the risk can increase.⁵⁶

2.37 The Marine Ecology Research Centre also accretion may also play a role. Accretion is a build-up of sand on beaches and in tidal areas caused by sediment movements. The Marine Ecology Research Centre observed that the Ballina and Byron Bay areas have seen high rates of accretion and explained how this can attract sharks closer to shore:

... sediment movements in the Ballina-Byron area have resulted in high rates of accretion of sand on beaches and in tidal areas. Accretion is linked to a strengthening El Nino weather pattern and smaller southerly/south-easterly swells, and has produced a very pronounced longshore parallel bar with deep water close to the beach. At present, the depth and proximity to shore of the channel produced by the longshore bar allows prey seeking refuge from larger predatory fish, and the sharks following them, to move closer to shore. The occurrence of deeper water closer to shore has also previously resulted in significantly higher incidence of white and tiger sharks in beach meshing programs in NSW and Queensland.⁵⁷

COMMITTEE COMMENT

2.38 The Committee heard evidence that it is not yet possible to reliably estimate the size of the shark population in NSW coastal waters. This is also the case for the

⁵² Submission 46, No Shark Cull Inc, p2.

⁵³ Submission 9, p3.

⁵⁴ Submission 9, p3.

⁵⁵ Dr Barry Bruce, 4 April 2016, p39.

⁵⁶ Submission 9, p1.

⁵⁷ Submission 9, p4.

three shark species identified as being responsible for attacks on humans. However, available evidence indicates that shark numbers have declined. Sharks play an important part in maintaining a healthy and balanced marine ecosystem, and their place in that system needs to be protected.

- 2.39 The Committee welcomes the ongoing research by the NSW Department of Primary Industries and the CSIRO, particularly the shark tagging program to monitor the movements of the east coast shark population and to estimate the size of the shark population.
- 2.40 The Committee was impressed with the results of the shark tagging program and the resultant data being accumulated. This data provides valuable information to marine scientists about shark behaviour. This research may also lead to a greater understanding of shark attacks.
- 2.41 The Committee also acknowledges the physical and psychological injuries survivors of shark attacks sustain, and the lifelong impact the incident can have on their lives. The Committee sympathises with the families and friends who have suffered bereavement due to a loved one dying as a result of a shark attack. Nonetheless sharks attacks are a rare and random occurrence.
- 2.42 While there is much we do not know about sharks, there is much that we do know. This information can break down some of the misunderstandings about sharks. Greater public awareness and understanding of shark behaviour can play a part in mitigating the risk of attack. This issue is explored in further detail later in this report.

Recommendation 1

The Committee recommends that the Department of Primary Industries continue scientific research into shark behaviour to improve understanding of shark behaviour and population size.

Chapter Three – Economic impact of shark encounters

- 3.1 The portfolio responsibilities of the Committee include regional development, primary industries, lands and water, as well as tourism and major events. For this reason, the Committee had an interest not only in the management of sharks but also in the economic impact of shark attacks, in terms of their potential effect on tourism and other industries.
- 3.2 The Committee commenced its inquiry in late August 2015, in the middle of winter. The Committee received no evidence to indicate that the shark incidents had had an impact on tourism in NSW as a whole, or even more specifically on the North Coast.
- 3.3 However, the Committee did receive strong anecdotal evidence that concerns about possible shark attacks have negatively impacted particular businesses. This evidence came primarily from Ballina, where three of the attacks occurred, and was focused on businesses related to surfing. This Chapter therefore reviews the evidence received by the Committee in relation to tourism and economic impacts, with a particular focus on the Ballina area.

Tourism in NSW

- 3.4 Any economic impact arising from shark incidents is likely to be seen first in the tourism sector. Tourism is a key industry for NSW, contributing \$34.9 billion to the NSW economy in the 2013-14 financial year. Destination NSW estimates that one in every 13 jobs in NSW is generated by tourism; the industry directly employs 159,000 people in NSW and indirectly employs a further 113,000.⁵⁸

Sydney

- 3.5 Sydney attracts a third of all visitors to NSW. The purposes of visits to Sydney vary, with more than 40 per cent visiting on holiday, 35 per cent to see relatives or friends, and about 15 per cent visiting for business reasons. More than 40 per cent of visitors to Sydney come from regional NSW.
- 3.6 Beaches are nonetheless a key attraction for both visitors and Sydney residents. Different species of sharks are known to be present in waters around Sydney and there have been attacks both within the harbour and at ocean beaches such as Bondi.⁵⁹ However, these have become very rare following closure of abattoirs that discharged waste into the harbour and sewage outlets close to popular beaches. There have been no attacks in the Sydney region in the last twelve months.

⁵⁸ Destination NSW, 'Economic contribution of tourism to NSW 2013-14,' <http://www.destinationnsw.com.au/wp-content/uploads/2014/04/economic-contribution-of-tourism-to-nsw.pdf>, Accessed 19 April 2016.

⁵⁹ West J. (2015) 'A review of shark attacks in the Sydney region', <https://taronga.org.au/sites/tarongazoo/files/downloads/A%20Review%20of%20Shark%20Attacks%20-%20Sydney%20Region1.pdf>.

- 3.7 The Committee received no evidence raising concerns about the impact of shark attacks on tourism in the Sydney region. The Sydney Coastal Councils Group provided a submission to the Inquiry, noting that:

At this stage, there is no concrete evidence that sharks are impacting on tourism and related industries. Nonetheless, the perceived risk of shark attack may have the potential to adversely impact on Australia's tourism industry in the short-term.⁶⁰

- 3.8 Further, the Committee received no evidence suggesting that tourism or related industries (such as accommodation) had been affected on a state-wide level. At time of writing, figures to travel to NSW were available for the year to September 2015. In the year to September 2015, visitors to NSW actually increased by 5.9 per cent.⁶¹ More recent data may reveal a change in this trend, but this appears unlikely.

The North Coast

- 3.9 The North Coast and, to a lesser extent, the Mid North Coast were particularly relevant to the inquiry. Most of the incidents involving sharks between late 2014 and late 2015 took place in these regions, with four incidents specifically around Ballina. Thus, if the incidents were to have an impact on tourism, it would most likely be in this area.
- 3.10 The North Coast of NSW is a popular tourist destination for both domestic and international visitors. Ms Belinda Novicky, Executive Officer, North Coast Destination Network, told the Committee that, 'We're very proud of what we have to offer as a region, in terms of natural assets, national parks, beautiful beaches and a great lifestyle.'⁶²
- 3.11 According to Destination NSW, the North Coast region (which takes in most of what might otherwise be considered the Mid North Coast, stretching from the Great Lakes to Tweed Heads) received nearly 4.6 million domestic overnight visitors in the year to September 2015, who spent \$2.5 billion between them. The region received another 292,000 international visitors.⁶³
- 3.12 Ms Novicky confirmed that 'tourism is big business for the North Coast', and the tourism industry a key economic driver for the region.⁶⁴ The Ballina Lighthouse and Lismore SLSC (where the Committee conducted its hearing on 26 November), observed that, 'Ballina's economy is heavily reliant upon tourism and large number of the local population enjoy pursuits such as swimming, surfing and diving'.⁶⁵ In a similar vein, Mr David Wright, Mayor of Ballina, gave evidence about the importance of tourism to the local economy:

⁶⁰ Submission 64, Sydney Coast Councils Inc., p2.

⁶¹ Destination NSW, 'Travel to NSW: Year ended September 2015', <http://www.destinationnsw.com.au/wp-content/uploads/2014/04/Total-NSW-snapshot-YE-Sep-15.pdf>, accessed 20 April 2016.

⁶² Ms Belinda Novicky, Executive Officer, North Coast Destination Network, Evidence, 26 November 2015.

⁶³ Destination NSW, 'Travel to North Coast NSW region: Year ended September 2015'.

⁶⁴ Ms Belinda Novicky, 26 November 2015.

⁶⁵ Submission 77, Ballina Lighthouse & Lismore SLSC Inc, p1.

This place would not exist ... without tourism. Our cafes out the front and all the food-related businesses desperately need tourists. We also have some very good accommodation areas. The other thing is that council owns the Ballina Byron Gateway Airport and on the figures for October we are the fastest growing airport in the country. While those visitors are going to Byron Bay, a lot of them are coming here.⁶⁶

- 3.13 Beaches are a key factor in the North Coast's tourism appeal. One participant in the Committee's meetings in Ballina described the North Coast as a 'beach economy', with swimming, surfing and recreational fishing all key drawcards to the region, among both visitors and residents alike. Again according to data from Destination NSW, 48.9 per cent of domestic visitors and 81.6 per cent of international visitors cited 'holiday' as the main purpose of their visit. Among domestic tourists nearly half (48.6 per cent) cited 'going to the beach as their most popular activity, and 22.5 per cent of international visitors.⁶⁷

Threat to tourism

- 3.14 With tourism and the appeal of beaches playing such an important part in the economy of the North Coast, any threat to the region's beaches is significant. Residents were very conscious of the threat posed by sharks, not only to the safety of swimmers but to the local economy. For example, Mrs Berenice Roberts, from Ballina, wrote in her submission, 'We are a tourist town and rely on people coming here to holiday and so man-eating sharks don't go down well.'⁶⁸
- 3.15 This fear that shark attacks would have a negative impact on tourism was expressed by a number of Inquiry participants. These concerns all came from people who were residents of Ballina and its surrounds. For example, the Far North Coast Shark Action Group wrote:

The impacts both socially and economically are being felt widely, with kids frightened to go in the water, and the thoughts of fewer summer visitors weighing heavily on the minds of local businesses.⁶⁹

- 3.16 These comments were made in October 2015, after there had been three attacks in the Ballina area and the peak tourist summer season was approaching. Such fears were expressed in the context of what to do about shark attacks. Some Inquiry participants explicitly looked to government to solve the problem, asking, 'what are you going to do for us locals & also all the local businesses that will have a huge downturn in income because people will not be holidaying here??'⁷⁰

The role of the media

- 3.17 Some Inquiry participants expressed the view that media coverage of shark attacks was as damaging as the attacks themselves, in terms of its impact on tourism. The fear of shark attack is often quite disproportionate to the likelihood

⁶⁶ Mr David Wright, Mayor, Ballina Shire Council, Evidence, 26 November 2016, p19.

⁶⁷ Destination NSW, 'Travel to North Coast NSW region: Year ended September 2015', <http://www.destinationnsw.com.au/wp-content/uploads/2014/04/North-Coast-NSW-region-YE-Sep-15.pdf>, accessed 20 April 2016.

⁶⁸ Submission 19, Mrs Berenice Roberts, p1.

⁶⁹ Submission 5, Far North Coast Shark Action Group, p1.

⁷⁰ Submission 12, Mrs Vicki Tymmons, p1.

of its occurrence. Further, media reporting of incidents involving sharks can exacerbate fears. Some Inquiry participants were critical of media coverage of recent attacks. For example, Cr Irene Doutney argued that media coverage of shark attacks is unhelpful, saying, 'Media reports have a tendency to hyperbolise the extent of the problem of these "man-eaters"'.⁷¹ Similarly, No Shark Cull observed that:

Shark bites sometimes occur in clusters and when this occurs the media typically report these events in sensationalist terms that have the resultant impact on the emotional state of people living in these areas.⁷²

- 3.18 The role of the media – and particularly the famous movie 'Jaws' – in instilling or exacerbating a fear of sharks has been examined by social scientists.⁷³ Moreover, such reports can influence behaviour and decision-making, thus impacting on tourism. Dr Christopher Neff, a researcher at the University of Sydney, has observed that cultural attitudes to sharks are shaped by the media:

Emotions are important because people make decisions about things based on more than what they think about something, but "how they feel" about it ... Primed with readily accessible reactions to shark bites, actual incidents can ignite a lack of public confidence in beach-going as well as a lack of confidence in government.⁷⁴

- 3.19 Some Inquiry participants expressed frustration with the intense media coverage surrounding the spate of shark incidents, and were concerned that this was bad publicity for the region. Some business owners, in particular, attributed impacts on their business to media coverage of shark incidents, rather than the incidents themselves.

Impact on businesses in Ballina

- 3.20 In submissions and evidence provided at the Committee's meetings on 26 November, the Committee heard that a number of local businesses in Ballina had been affected by the cluster of shark attacks in the area. In September 2015, the North Coast Destination Network surveyed 89 tourism-related businesses across the region and found that 67 per cent reported no impact on their business.⁷⁵
- 3.21 A significant proportion of affected businesses reported simply an increase in inquiries about beach safety, which may not indicate reduced demand.⁷⁶ For example, Ms Novicky reported that there was little evidence in an impact on family tourism; families with children are frequently safety-conscious and deliberately choose well-attended, patrolled beaches where shark incidents are less likely to occur.⁷⁷

⁷¹ Submission 47, Cr Irene Doutney, p2.

⁷² Submission 46, No Shark Cull Inc, p2.

⁷³ Neff, C. (2015) 'The Jaws effect: How movie narratives are used to influence policy responses to shark bites in Western Australia', *Australian Journal of Political Science*, 50, 1, pp.114-127.

⁷⁴ Neff, C. (2012) 'Australian beach safety and the politics of shark attacks,' *Coastal Management*, 40, pp. 101-2.

⁷⁵ Submission 37, North Coast Destination Network, p1.

⁷⁶ Submission 37, p1.

⁷⁷ Ms Belinda Novicky, 26 November 2015.

ECONOMIC IMPACT OF SHARK ENCOUNTERS

3.22 Some participants in the Inquiry were sceptical of any financial impact that could be attributed to shark incidents. For example, Sea Shepherd Australia noted that visitor numbers tend to fluctuate and show little or no relationship to incidents involving sharks.⁷⁸ Sea Shepherd argued that reports of effects on individual businesses could be attributed to other factors:

The only examples whereby the tourism industry is allegedly hurt as a result from shark encounters, come from anecdotal opinions of business owners, which is neither reliable nor credible.⁷⁹

3.23 However, the Committee received evidence of a direct impact on some businesses, which reported cancellations in bookings or reduced sales.⁸⁰ The Committee received several anecdotal reports of reduced demand or cancellations in the accommodation sector.⁸¹ For example, Mr David Borrack wrote that 'I have seen multiple families who turn up at annually for spring Holidays at Broken Head and Clarkes Beach Byron Bay caravan parks cancel this year.'⁸²

3.24 The Committee received conflicting evidence from accommodation providers, with some reporting a downturn in business and others not. For example, the Committee received a submission from the Lennox Head BeachHouse, a backpackers' hostel popular with both Australian and international backpackers, saying that, 'We have not experienced any downturn in accommodation bookings because of the attacks. Our occupancy rate has stayed the same.'⁸³

3.25 On the other hand, the Committee also received a submission from Grandview Apartments in Ballina, which reported that it had experienced a 30 per cent reduction in bookings over the quarter July to September 2015.⁸⁴ In a similar vein, the Ballina Shire Council reported that bookings at its Flat Rock Tent Park had declined significantly from previous years, with some groups explicitly referring to concerns about shark attacks while cancelling bookings.⁸⁵

Surf tourism

3.26 The sector which reported an unequivocal decline in demand was surf tourism, comprising sale of surfboards and accessories, and conduct of surfing lessons. For example, at the public hearing on 26 November, Mr David Wright, Mayor, Ballina Shire Council told the Committee that, 'the tourist shops seem to be doing okay. Those who rely on anything to do with surf clothing or stuff like that, I am certain their business is down.'⁸⁶

⁷⁸ Submission 6, Sea Shepherd Australia Ltd, p19.

⁷⁹ Submission 6, p19.

⁸⁰ Submission 37, North Coast Destination Network, p1.

⁸¹ See Submission 10, Submission 4, Submission 7, Submission 48.

⁸² Submission 4, Mr David Borrack, p1.

⁸³ Submission 35, Anna Dicker, p1.

⁸⁴ Submission 81, Grandview Apartments Ballina, p1.

⁸⁵ Submission 57, Ballina Shire Council, p3.

⁸⁶ Mr David Wright, Mayor, Ballina Shire Council, Transcript of evidence, 26 November 2015, p21.

3.27 Surfing NSW gave evidence detailing the importance of surf tourism in NSW. Surfing is a growth industry and plays a significant role in the tourist industry, contributing over \$500 million each year to the NSW economy.⁸⁷ Moreover, research into surf tourism has found that:

Surfers average more distance than most holiday goers so we have found that their trips are slightly longer stays than others. They fight the seasonality and contribute to an increase of consumption in caring, accommodation, heritage and other resources, simultaneously identifying with local communities.⁸⁸

3.28 With all of the shark incidents in 2014-2015 involving surfers, it is not surprising surfing was the industry most affected. The Committee heard strong evidence about the impact on surfing-related businesses such as surfboard makers, retailers of surfboards and surfing accessories, and proprietors of surf schools. For example, Surfing NSW told the Committee that surf shops on the Far North Coast had been particularly affected:

Three surf shops have shut on the Far North Coast of NSW. Other independent surf shops are also suffering a downturn in trade with one store owner in Ballina stating that surfing accessories sales have fallen 80%... All Independent surfboard manufacturers in the region who took part in the survey reported a down turn in trade.⁸⁹

3.29 This trend was confirmed by the North Coast Destination Network, which found that the economic impact of shark incidents was concentrated in surfing-related businesses. Some surfing retailers reported a downturn in business of 50 per cent, with losses of as much as \$25,000.⁹⁰ While increased competition accounted for part of this downturn, the bulk of it was attributable to shark attacks. For example, Mr Richard Beckers, proprietor of a surfing store in Ballina, told the Committee that:

The shark attacks have had a massive impact on my business with some areas down 90%. In the last month I have cancelled over 100k worth of surf accessories.⁹¹

3.30 The Committee heard similar evidence from surfboard makers. Mr Wayne Webster of Webster Surfboards attended a meeting with the Committee in Ballina on 26 November and told the Committee that there was a perceptible drop in demand after each shark incident. His business had suffered a massive decline in demand of as much as 75 per cent. Surfing NSW reported confirmed this, saying that 'all independent surfboard manufacturers in the region who took part in our survey reported a down turn in trade'.⁹²

3.31 Similarly, the Committee also heard evidence of a significant reduction in demand for surfing lessons. Surfing NSW told the Committee that schools licensed by Surfing NSW deliver more than 300,000 surfing lessons a year; surf

⁸⁷ Submission 48, Surfing NSW, p12.

⁸⁸ Submission 48, p12.

⁸⁹ Submission 48, p14.

⁹⁰ Submission 37, North Coast Destination Network, p1.

⁹¹ Mr Richard Beckers, Ballina Surf, Document tendered at public hearing, 26 November 2015, p1.

⁹² Submission 48, p14.

school operators also reported a downturn.⁹³ The Committee also received reports of declining demand for surf schools further south, around Port Macquarie.⁹⁴ There was a shark attack near Port Macquarie in August 2015.

Increased costs

3.32 The Committee also heard evidence regarding increased costs for those organisations charged with preventing or responding to shark incidents. These costs are borne largely by local councils and surf lifesaving clubs. For example, Mr Brent Manieri, Manager, Australian Lifeguard Service, told the Committee about the response to a shark sighting on the south coast:

We did see over the summer period Shoalhaven City Council put on lifeguards at Hyam's Beach after there was a report in the newspaper of a school of small bronze whaler sharks in the area. The lifeguards sitting on that headland did not spot one shark in the entire two weeks that they were there... It was basically a waste of money.⁹⁵

3.33 As the Ballina Shire Council pointed out in its submission, managing the marine environment is not part of the jurisdiction of local councils. Councils undertake such activities in order to protect their local communities and address threats to the tourist industry. Ballina Shire Council told the Committee that, to November 2015, it had spent at least \$30,000 in excess of its usual costs to support additional aerial surveillance of local beaches.⁹⁶

3.34 In a similar vein, the Ballina Lighthouse and Lismore SLSC reported that use of its resources and equipment in responding to increased shark sightings had 'resulted in a significant increase in our normal operating costs'.⁹⁷ As a volunteer organisation, the SLSC meets these costs through its own fundraising. The Jet Boat Rescue Service, another volunteer organisation, also reported increased costs arising from arising from shark sightings and encounters.⁹⁸

The burden on volunteers

3.35 While some local councils employ professional lifeguards, most patrolling of beaches is carried out by volunteer surf lifesaving clubs. Thus the task of responding to shark sightings or attacks usually falls to these volunteers in the first instance. Surf Life Saving NSW advised that, over the summer period 2014-2015, the 129 surf lifesaving clubs in NSW performed 5,902 rescues, 138,775 preventative actions and provided 9,199 first aid responses.⁹⁹

3.36 The Committee heard evidence of the increasing burden on volunteer services in areas where there had been increased numbers of shark sightings. For example, Surf Life Saving NSW explained the effect of increasing shark sightings in the North Coast region:

⁹³ Submission 48, p14.

⁹⁴ Submission 66, Port Macquarie-Hastings Council, p1.

⁹⁵ Mr Brent Manieri, Manager, Australian Lifeguard Service, Transcript of evidence, 4 April 2016, p25.

⁹⁶ Submission 57, Ballina Shire Council, p4.

⁹⁷ Submission 77, Ballina Lighthouse and Lismore SLSC Inc., p1.

⁹⁸ Submission 57, p4.

⁹⁹ Submission 55, Surf Life Saving NSW, p1.

between July and the end of September, our Emergency Response System received 53 callouts, compared to 4 at the same time last year, which is an increase of 1225%.¹⁰⁰

- 3.37 Mr Graham Kent, Life Saving Manager, Surf Life Saving NSW, described the effect on volunteers in local clubs:

Some clubs are more affected than others. Certainly initially it was the guys who operate the jet boats who are out there a lot, and the clubs in the Ballina and Lennox areas. The duty officer system that we have up there, the amount of work they were doing initially was tremendous, so they were almost very tired of doing it.¹⁰¹

- 3.38 The Ballina Lighthouse and Lismore SLSC, which was particularly affected by the increased number of incidents in that area, described the effect on volunteers at the club:

Involvement in the recent incidents has resulted in a significant drain on our members who have often taken leave from their workplace in order to attend these incidents and subsequent meetings.¹⁰²

- 3.39 Volunteers who were involved in responding to shark incidents also experienced a personal cost. Ballina Lighthouse and Lismore SLSC reported that 'a number of our members were at the frontline of these incidents which has had a traumatic effect on them personally as well as our broader membership'.¹⁰³

- 3.40 The traumatic effect of a shark attack on first responders can also deter volunteers from joining or continuing their involvement in surf lifesaving. For example, one Inquiry participant explained why she had decided not to continue surf lifesaving duties:

I am a volunteer surf lifesaver and am choosing not to do active service at the moment due to lack of procedures put into place for my welfare. Even if I don't perform water rescue I can still be put into the position of responsibility to provide life support. I have seen first-hand how this has permanently changed the lives of a number of people in my community post the death of [a man] at Speeds (Ballina), and others involved in assisting with recent maulings.¹⁰⁴

- 3.41 The Ballina Lighthouse and Lismore SLSC advised that its membership had fallen by 15 per cent from the previous year. The Club advised that while there were a number of reasons for this decline, the level of shark activity was cited as a reason by some former volunteers.¹⁰⁵ This negative impact on volunteering, in turn, increases the burden on remaining club members.

Seasonal variations

- 3.42 Most of the evidence cited in this chapter was received in October and November of 2015. Inquiry participants from the North Coast expressed deep concerns

¹⁰⁰ Submission 55, Surf Life Saving NSW, p2.

¹⁰¹ Mr Graham Kent, Life Saving Manager, Surf Life Saving NSW, Transcript of evidence, 4 April 2016, p28.

¹⁰² Submission 77, Ballina Lighthouse and Lismore SLSC Inc., p1.

¹⁰³ Submission 77, p1.

¹⁰⁴ Submission 20, name suppressed, p1.

¹⁰⁵ Submission 77, p1.

about the possibility of further shark attacks over the approaching summer, with a corresponding impact on local businesses.

- 3.43 However, there were no further shark incidents on the North Coast during the summer 2015-2016 period. At time of writing, visitor data to December 2015 is available, and this data shows no decline in visitor numbers in the North Coast region.¹⁰⁶ Anecdotal reports from local residents also indicate that the 2015-2016 summer tourist season was within the normal range. For example, at the public hearing on 4 April 2016, Mr Don Munro gave his impression of the impact of the shark attacks on local businesses on the North Coast:

In the case of our area here, with three to four very severe attacks—one fatal—it slowed everything down in terms of surfboard sales and aligned products. Economically in that case, yes, it did but it is coming back to normal now. I am still surveying people and from my research it is almost back or is back to an even keel again. The accommodation, houses and what have you, they did falter a little before Christmas, then over Christmas and the holiday period everyone seemed to come through it okay. Right now from my feedback it is back to an even keel, as I said before.¹⁰⁷

COMMITTEE COMMENT

- 3.44 The Committee was very impressed by the level of community engagement and cooperation shown by local residents in the North Coast area in responding to the spate of shark attacks in 2014 and 2015. While residents had differing views about the best way to prevent further attacks, residents shared a deep concern for their community and for those individuals most affected by the attacks.
- 3.45 Available evidence indicates that a cluster of shark attacks does have an impact on the activities that both tourists and residents undertake, and that this can have a consequent impact on local businesses. While significant, these impacts are localised, specific to particular industries, and temporary. Further research is needed in this area.
- 3.46 Unfortunately the random nature of shark attacks makes planning to address any related economic impacts extremely difficult. Educating the public about the real risk of shark attacks and strategies to prevent attacks may be the most effective means of preventing any negative impact on tourism and related industries.

Recommendation 2

The Committee recommends that Destination NSW conduct research to determine the impact of shark attacks on tourism and related industries, using the recent spate of incidents on the NSW North Coast as a case study.

¹⁰⁶ Destination NSW, see <http://www.destinationnsw.com.au/wp-content/uploads/2016/04/North-Coast-NSW-region-YE-Dec-15.pdf>, Accessed 29 April 2016.

¹⁰⁷ Mr Don Munro, Member, Bite Club, Transcript of evidence, 4 April 2016, p60.

Chapter Four – Mitigation of risk of shark attacks

- 4.1 This chapter examines the various existing and emerging shark deterrent technologies, particularly in the context of the NSW Government's Shark Management Strategy.

NSW GOVERNMENT SHARK MANAGEMENT STRATEGY

- 4.2 In October 2015 the NSW Government announced the Shark Management Strategy. The Strategy involves a multi-faceted approach to detecting and deterring sharks, with more than \$16 million to be invested over five years to introduce innovative trials and fund continuing projects.¹⁰⁸

- 4.3 Mr Scott Hansen, Director General, NSW Department of Primary Industries, advised that the Strategy 'has two key components: how do we reduce risk to bathers and those who utilise NSW waters, and how do we minimise the impact on the environment?'¹⁰⁹ Mr Hansen went on to explain how the Strategy was developed:

We identified key areas around the globe that were experiencing or had progressed the most significant amount of work in their area of mitigation steps. We invited all of those countries, those government scientists to a Shark Summit in New South Wales to help weave through what was and what was not working and where should we try a multiple investment approach to trial new technologies simultaneously to see what path forward we should take in terms of new technologies and new tools for reducing risk.¹¹⁰

- 4.4 The Strategy has three elements: education and community engagement; research and surveillance, and detection and deterrence. In relation to research, Mr Hansen explained that there is a gap in knowledge regarding shark behaviour and also ecology that the Government is attempting to address:

... we have funding for three PhD positions to help build scientific knowledge within the State with regards to shark ecology, shark mitigation and shark detection technologies. We have a grants program that we are looking to roll out, because we are aware that government is not the font of all knowledge in this space; and in fact there are good entrepreneurs out there who are coming up with solutions and ideas. The grants program is designed to help fast-track proof and trial of those technologies and to take them to market quicker. So those are the key components within our research area.¹¹¹

¹⁰⁸ New South Wales Department of Primary Industries, *Shark management: Shark Management Strategy*, Accessed 11 May 2016, <http://www.dpi.nsw.gov.au/fishing/sharks/shark-management>

¹⁰⁹ Mr Scott Hansen, Director General, New South Wales Department of Primary Industries, Transcript of evidence, 4 April 2016, p2.

¹¹⁰ Mr Scott Hansen, 4 April 2016, p5.

¹¹¹ Mr Scott Hansen, 4 April 2016, p5.

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- 4.5 On the key element of surveillance, detection and deterrence, Mr Hansen emphasised the importance of aerial surveillance as a method for shark attack mitigation:

... we will be continuing our aerial surveillance. Obviously being able to see a shark in the water and notify beachgoers is a pretty powerful tool in terms of protection. To be able to see into the water requires many environmental conditions to be right at any one point in time, and it needs also to be done from some height.¹¹²

Components of the strategy

- 4.6 The Strategy is comprised of a number of measures including public education and awareness campaigns, and shark surveillance, detection and deterrents such as shark tagging, shark spotting and beach meshing. The Government is also trialling new shark deterrent and detection technologies.¹¹³

Beach meshing

- 4.7 Shark nets or meshing have been used in NSW since the late 1930s. The Government's new Shark Management Strategy incorporates the existing Shark Meshing (Bather Protection) program. The Committee received a large number of submissions related to shark meshing, and the issue of shark meshing is discussed in Chapter Five.

Eco-barriers

- 4.8 The Department of Primary Industries is trialling two eco-friendly shark barriers – one at Seven Mile/Lennox Head Beach and another at Lighthouse Beach Ballina. The trial at Lennox Head is testing the Aquarius Barrier, manufactured by Global Marine Enclosures.¹¹⁴ The barrier is a combination of thick horizontal marine ropes and vertical durable nylon struts. It is designed to work on beaches subject to high-energy ocean forces.¹¹⁵ The trial at Lighthouse Beach involves testing the Eco Shark Barrier manufactured by Eco Shark Barrier Pty Ltd. This barrier is constructed of strong, flexible nylon. It is designed to be adaptable allowing it to be installed on a variety of beach types.¹¹⁶
- 4.9 This type of barrier is a physical barrier that either wholly, or in part, separates sharks from water users. The barriers are not designed to capture sharks or any other marine life. Rather, they are a non-lethal barrier as smaller creatures can swim through holes in the barrier while larger ones are unable to penetrate it.¹¹⁷
- 4.10 The trial of the Aquarius Barrier is scheduled to begin in August 2016. The Eco Shark Barrier trial was scheduled to begin in April 2016 but has been delayed due sand movements on the beach as a result of recent bad weather. The trial will

¹¹² Mr Scott Hansen, 4 April 2016, p6.

¹¹³ Submission 58, New South Wales Department of Primary Industries, p2.

¹¹⁴ Mr Scott Hansen, Answers to Supplementary Questions, 6 May 2016.

¹¹⁵ Global Marine Enclosures, *Aquarius Barrier*, Accessed 8 June 2016, <http://www.globalmarineenclosures.com/aquarius-barrier/>

¹¹⁶ Eco Shark Barrier Pty Ltd, *The Product: Eco Shark Barrier*, Accessed 12 May 2016, <http://www.ecosharkbarrier.com.au/the-product/>

¹¹⁷ See: <http://www.globalmarineenclosures.com/aquarius-barrier/> and <http://www.ecosharkbarrier.com.au/the-product/>

commence once the profile of the beach has returned to a more normal position.¹¹⁸ The trials will determine whether or not the barriers can be used effectively on other beaches, particularly on beaches that have a more dynamic environment in terms of wave activity.¹¹⁹ Both trials are scheduled to last three years, with an expected end date of August 2019, and will be subject to annual reviews.¹²⁰

Shark tagging

- 4.11 As discussed earlier in this report, the Department of Primary Industries, in conjunction with the CSIRO, is currently undertaking a shark tagging program. Several listening stations have been deployed along NSW coastal waters. The information captured will assist in understanding shark movements and behaviour.¹²¹
- 4.12 Over the next five years the Department of Primary Industries will increase the size of shark tagging program. The expansion of the program will see more sharks tagged and improvement in the program's detection and reporting capabilities.¹²²

Sonar technology

- 4.13 In addition to the eco-friendly shark barriers, a trial of the use of in-water sonar technology is being undertaken at Bondi Beach. The 'Clever Buoy' uses new sonar technology linked to specially tailored software to detect shark sized objects underwater and transmit this information to shore. The Clever Buoy has intuitive software that continues to develop and learn the details of what it is designed to detect. This allows it to overcome the limitation of more traditional sonar technology which is unable to reliably and consistently detect the presence of sharks.¹²³
- 4.14 The initial Clever Buoy sea trials have been completed. The Department of Primary Industries will conduct additional trials to determine the effectiveness of the technology in detecting untagged sharks.¹²⁴ Early indications are promising that the technology will be able to work as intended.¹²⁵

Aerial surveillance

- 4.15 The Government has also committed to ongoing aerial surveillance. In April 2016 the Minister for Primary Industries announced that aerial shark patrols will be conducted year-round for the next 12 months. The surveillance will take place on

¹¹⁸ Mr Scott Hansen, Answers to Supplementary Questions, 6 May 2016.

¹¹⁹ New South Wales Department of Primary Industries, *Shark management: Shark Management Strategy*, Accessed 12 May 2016, <http://www.dpi.nsw.gov.au/fishing/sharks/shark-management>

¹²⁰ Mr Scott Hansen, Answers to Supplementary Questions, 6 May 2016.

¹²¹ New South Wales Department of Primary Industries, *Shark management: Shark Management Strategy*.

¹²² New South Wales Department of Primary Industries, *Shark management: Shark Management Strategy*.

¹²³ Clever Buoy, *FAQS*, Accessed 13 May 2016, <https://cleverbuoy.com.au/fag>

¹²⁴ NSW Department of Primary Industries, *Shark management: Shark Management Strategy*.

¹²⁵ Mr Scott Hansen, 4 April 2016, p7.

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selected weekdays, weekends, school holidays and public holidays until April, 2017.¹²⁶

- 4.16 Mr Hansen explained that the Department is moving toward the use of unmanned aerial vehicles (UAV's) or drones to conduct aerial surveillance:

Traditionally we have relied on aerial surveillance by helicopters and fixed-wing aircraft. We are now using choppers up and down the coastline in terms of our surveillance activity and surveillance programs. However, we are investing in trials to take the next step. The next step is actually to use drones which are unmanned.

- 4.17 Trials of drones began in December 2015 and are scheduled to continue during 2016 at various coastal locations. Drone technology not only provides aerial surveillance but does so with real-time vision of the area under surveillance.¹²⁷ It is envisaged that drone technology will advance to the stage where it will be able to detect tagged and untagged sharks.¹²⁸

- 4.18 While still in the trial phase, early indications of the use of drones by the Department of Primary Industries are positive. Mr Hansen advised the Committee that the Department is currently trialling the use drones:

We have already conducted a number of trials year to date in which we have flown the drones simultaneously alongside our manned aerial surveillance to check performance.

So far we have had really pleasing and successful outcomes from those early trials. We can see a day in the future when smaller drones operated by those on the beach will be able to provide regular surveillance of the water which swimmers, bathers and surfers are in, and maybe some bigger drones operating along the coastline would be the next step. We are at an advanced stage in terms of trialling that and working out where it fits into the overall surveillance strategy.¹²⁹

- 4.19 A common problem for all surveillance is that visibility can be limited. This applies equally to aerial and non-aerial surveillance. Visibility can be limited by environmental factors such as the depth of water, overhead cloud cover, rain and the reflected glare of sunlight on the water.

SMART drumlines

- 4.20 Another eco-friendly technology being trialled is the SMART (Shark Management Alert in Real Time) drumline. The SMART drumline differs from the traditional drumline as it is not designed to kill sharks. SMART drumlines are fitted with an alarm that alerts a response team when a shark is caught in the line. The drumlines are only deployed when a team is available to respond immediately. The response team will tag and potentially relocate the shark. Initial testing of

¹²⁶ NSW Department of Primary Industries, Media Release: Aerial shark surveillance to be conducted year-round, Accessed 11 May 2016, http://www.dpi.nsw.gov.au/_data/assets/pdf_file/0009/639063/aerial-surveillance-to-be-conducted-year-round-160419.pdf

¹²⁷ NSW Department of Primary Industries, *Shark management: Shark Management Strategy*.

¹²⁸ Mr Scott Hansen, 4 April 2016, p8.

¹²⁹ Mr Scott Hansen, 4 April 2016, p6.

the SMART drumline technology took place at Bellinger River, south of Coffs Harbour, in late 2015.¹³⁰

- 4.21 Further trials were carried out in early 2016 in the Richmond, Bellinger, Hastings and Manning rivers and Harrington Lagoon. Trials also took place at ocean beaches at Ballina, Evans Head, and Port Stephens. The three target species of the trials are white sharks, bull sharks and tiger sharks. Trials indicate SMART drumlines are effective for safely catching white sharks and bull sharks, with three and five sharks caught and tagged and released, respectively. The Department has protocols in place during the trial to ensure the lines are checked hourly, with all animals attended to within minutes of being hooked. The white and bull sharks were tagged and released within 30 minutes of being hooked.¹³¹
- 4.22 The SMART drumline trials will continue during 2016, including targeting tiger sharks. The adaptive trials will also shift to the drumlines being unattended and rely solely on the trigger-satellite alert system as intended by the Reunion Island scientists and fishers that developed the system. Scientists will remain on standby and close to the site of the drumlines during the shift to a fully automated system. Those trials will start at Coffs Harbour in mid-2016 and extend to other coastal waters during the year, depending on the distribution of the target species.¹³²
- 4.23 The Department will also support the management strategy through annual competitive grants and funding to promote research and further innovation in detection and deterrent technologies. It will also recruit additional expert staff to support the roll out of the strategy.¹³³

Observation Tower Grant Program

- 4.24 The Department of Primary Industries administers the Observation Tower Grant Program, which has now been integrated into the Shark Management Strategy. The program provides funding for the construction of up to ten observation towers in NSW each year.
- 4.25 Observation towers are constructed on beaches or headlands and serve a dual purpose, being used both for shark spotting purposes and also for identifying people who may get into difficulty while swimming. Applications for the tower program are received from surf lifesaving clubs and local councils. The applications are assessed against set criteria that includes:
- Consideration of beach existing observation facilities
 - Provision for ongoing maintenance of the facilities by the applicant
 - The number of annual beachgoers visiting the beach

¹³⁰ NSW Department of Primary Industries, *Shark management: Shark Management Strategy*.

¹³¹ Mr Scott Hansen, Answers to Supplementary Questions, 6 May 2016

¹³² Mr Scott Hansen, Answers to Supplementary Questions, 6 May 2016

¹³³ NSW Department of Primary Industries, *Shark management: Shark Management Strategy*.

- The number sharks sighted in the past two years and the frequency of sightings near swimmers
- The number of hours the tower will be in use annually.¹³⁴

4.26 Funding for the program is to be brought forward by a year to allow for construction of extra towers in 2015-2016.¹³⁵

Specific North Coast response

4.27 Following the spate of shark related incidents on the North Coast in 2015, the Department of Primary Industries announced that a number of the initiatives announced in the Strategy would be deployed or trialled in that region. The initiatives include:

- Trial of eco-barriers at Lighthouse Beach, Ballina and at Seven Mile Beach, Lennox Head – as discussed earlier in this chapter
- Five beaches on the North Coast will have VR4G shark listening stations – shark tagging and targeted aerial surveillance will continue off the North Coast – also discussed earlier in this chapter
- A range of SharkSmart material specifically designed for the North Coast – posters, brochures and radio community service announcements – were distributed across the region¹³⁶ – further information regarding information strategies is discussed in Chapter Six.

4.28 Additional North Coast initiatives include the following:

- North Coast Shark Tagging Project led out of Ballina by the Department of Primary Industries' shark biologist, as discussed previously,
- Deployment of Department of Primary Industries Fisheries boats to assess local conditions and to inform research tasks – noting the presence of schools of bait fish as they are known to attract sharks, current and water temperature trends
- Partnership with local surf clubs – every Surf Life Saving NSW club along the North Coast supplied with SharkSmart campaign materials and information
- Fast-tracked lookout towers funding from the Towers Grant Program
- Maintaining strong representation on the Ballina Shire Shark Mitigation Advisory Group.¹³⁷

¹³⁴ NSW Department of Primary Industries, *Shark management: Shark Management Strategy*.

¹³⁵ Dr Geoffrey Allan, Deputy Director General, Department of Primary Industries, Transcript of evidence, 4 April 2016, p5.

¹³⁶ NSW Department of Primary Industries, *Shark management: Shark Management Strategy*.

¹³⁷ Submission 58, NSW Government, p3.

FEEDBACK FROM STAKEHOLDERS

- 4.29 The Committee received a range of feedback on the Shark Management Strategy; most such feedback related to particular initiatives (such as shark meshing) rather than to the Strategy as a whole.

Shark surveillance and deterrents

- 4.30 In its submission to the Inquiry, the Marine Ecology Research Centre noted that many shark deterrent technologies are still under development but suggested that the North Coast area provides an excellent environment to test new technologies:

Alternative technologies for excluding sharks from areas of human use are still in development, are equally expensive, and would not protect surfers on point breaks and remote beaches. ... If such technologies are to be trialled, the North Coast of NSW with all three dangerous shark species in all seasons and specific bycatch issues is the ideal testing ground.¹³⁸

- 4.31 The Humane Society International, in its joint submission with the Australian Marine Conservation Society and Greenpeace Australia Pacific advised that it was 'pleased that the NSW Government has moved away from introducing more shark nets and is looking at alternative technologies' that conserve marine life.¹³⁹

- 4.32 No Shark Cull noted the successful trial of the Eco Shark Barrier in Western Australia.¹⁴⁰ However, Ms Sharnie Connell, Chairperson, No Shark Cull was critical of the decision to trial the Eco Shark Barrier at Lighthouse Beach near Ballina. Ms Connell observed that in Western Australian the barrier was installed on a relatively flat beach whereas in NSW the barrier will be 'on a very heavy surf beach. I have heard that they can get up to 25-foot swells there during a storm ... Personally I feel that they are setting this Eco Shark Barrier trial up to fail.'¹⁴¹

- 4.33 Some Inquiry participants were also critical of the Government's decision to deploy SMART drumlines. For example, the Humane Society questioned claims that these new drumlines are non-lethal.¹⁴² Ms Connell echoed this criticism, arguing that:

The smart drumline is like a drumline. It is basically a baited hook on a buoy so it is attracting sharks to the area. No Shark Cull is very concerned about attracting sharks towards swimmers and bathers. The smart component comes in because it has some sort of mechanism—I think it is a solar panel—that allows it to send a message to the operator to say that something has been caught on the hook.¹⁴³

¹³⁸ Submission 9, Marine Ecology Research Centre, School of Environment Science and Engineering, Southern Cross University, p6.

¹³⁹ Submission 71, Humane Society International, p8.

¹⁴⁰ Submission 46, No Shark Cull Inc, p17.

¹⁴¹ Ms Sharnie Connell, Chairperson, No Shark Cull Inc, Transcript of evidence, 4 April 2016, p18.

¹⁴² Submission 71, Humane Society International, p8.

¹⁴³ Ms Sharnie Connell, 4 April 2016, p16.

Aerial patrols

4.34 The Committee received a number of submissions advocating for greater use of aerial patrols, both fixed wing and rotary.

4.35 Arguments were presented that fixed wing aircraft are more effective – both in terms of shark surveillance and operational costs. Mr Harry Mitchell, General Manager, Australian Aerial Patrol, explained the advantages of fixed wing aircraft:

The high wing creates a wonderful platform because we have no obstructions underneath. The pilot is just that; he is the driver. The mission coordinator is in the front right-hand seat, he has the wherewithal of how to conduct the flight and he is in communication with all the emergency frequencies we have on the radio. Then he is also an observer and we have observers in the back. In terms of the fixed-wing, we can cover a larger area, a longer area, in a shorter time. I use the analogy that we are the legs and rotary are the arms. I think there is an application for both, but in the type of surveillance that we are doing and given the area that we have, the fixed-wing is, in my mind, the better platform.¹⁴⁴

4.36 While more expensive to operate in comparison to fixed wing aircraft, rotary wing aircraft (i.e. helicopters) are also an effective means of aerial patrol. The Department of Primary Industries does use helicopters. One Inquiry participants observed that helicopters can also be used to drive sharks away from shore:

The helicopter's downwash on the water can be used to drive the shark in any desired direction by manoeuvring the helicopter in a low and slow hover. I have seen this technique applied on several occasions and was most recently employed to drive a Bronze Waler shark away from a Junior Surf Carnival, following an attack on a nearby diver at Narrawallee NSW. The inability of fixed wing aircraft to manipulate the shark's direction of travel is what sets the helicopter apart, as a far more effective solution.¹⁴⁵

4.37 Mr Hansen emphasised that the current manned aerial patrols provide beachgoers with confidence that their safety is being monitored, saying that 'Swimmers and surfers in the water see the choppers go over on a daily basis during school holidays and weekends. It provides an immediate benefit for those people.'¹⁴⁶

4.38 Manned aircraft are able to cover large distances of coastline but the associated running and maintenance costs are high. For example, the Ballina Shire Council advised that it has incurred costs in excess of \$30,000 to support aerial surveillance for a large surfing event and for weekend surveillance.¹⁴⁷ The use of unmanned aerial patrols or drones therefore offers the opportunity to provide a similar aerial surveillance program at a reduced cost.

¹⁴⁴ Mr Harry Mitchell, General Manager, Australian Aerial Patrol, Transcript of evidence, 4 April 2016, p33.

¹⁴⁵ Submission 23, Mr Euan McKenzie, p2.

¹⁴⁶ Mr Scott Hansen, Director General, NSW Department of Primary Industries, Transcript of Evidence, 4 April 2016, p7.

¹⁴⁷ Submission 57, Ballina Shire Council, p4.

Shark spotters

4.39 In addition to aerial surveillance the Committee was also advised about the Shark Spotters program. This is a land-based shark observers program that has been used in Cape Town for 11 years. Spotters are located in an elevated position – on a headland or in a tower – and use a flag alert system to warn bathers of shark sightings and the spotting conditions each day.¹⁴⁸

4.40 Ms Connell argued that a Shark Spotters program could be integrated with continue use of aerial patrols:

... aerial patrol covers a long range and I believe in integrating these methods as much as possible. I do not believe there is any one method. Shark spotting is conducted over one beach at a time, so it is constant surveillance. Basically, what they are looking for are changes. It might be that you have got a cloud that will make it very difficult to see into the water but that cloud will then move. It is looking for changes. It is difficult to do that from a moving perspective. When you have got a drone or when you are in a helicopter it is very difficult to see changes, whereas when someone is static they are much more able to see the changes.¹⁴⁹

4.41 No Shark Cull was critical of the lack of support for the program from government.¹⁵⁰ Sea Shepherd Australia echoed these criticisms. Sea Shepherd argued that Shark Spotters is a viable ‘non-lethal alternative’ to shark meshing and provides ‘a balance between human needs and those of our natural assets’.¹⁵¹ Moreover, Shark Spotters is existing technology which ‘could be implemented easily and immediately’.¹⁵²

4.42 However, Surf Life Saving NSW raised concerns about whether it would be possible to implement the Shark Spotters program in Australia. For example, Mr Andrew Kent, Life Saving Manager, Surf Life Saving NSW, questioned whether funding of shark spotters would be cost effective:

As a weigh up of options is it better for councils to support drowning prevention, bear in mind we have had 40 coastal drownings in New South Wales this financial year already, and better bang for the buck funding more lifeguard services or funding shark spotters?¹⁵³

4.43 Mr Kent also pointed out the height required for shark spotters to effectively observe the water is not often available at beaches in NSW:

I think if we are going down this path—again the height which is needed on those South African beaches is sometimes 40 metres of height of elevation which they are recommending to look down and use this strategy effectively—in New South Wales there are very limited spots to do that anyway. In some cases maybe, but I do not

¹⁴⁸ Submission 6, Sea Shepherd Australia Ltd, p23.

¹⁴⁹ Ms Sharnie Connell, 4 April 2016, p15.

¹⁵⁰ Ms Sharnie Connell, 4 April 2016, pp14-15.

¹⁵¹ Submission 6, p23.

¹⁵² Submission 6, p23.

¹⁵³ Mr Andrew Kent, Life Saving Manager, Surf Life Saving NSW, Transcript of Evidence, 4 April 2016, p24.

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think it is an approach which would actually be beneficial compared to other strategies.¹⁵⁴

- 4.44 The Committee also heard that the existing Observation Tower Grant Program is well known and fully subscribed. Dr Geoffrey Allan, Deputy Director General, Department of Primary Industries, informed the Committee that:

Every year since 2011 we have run a program. It is \$30,000 a year and it has been fully subscribed and we have proceeded to expend that money. We brought it forward last year, in 2015, and I think the applications closed in October. The program has funded a whole range of things, not only towers but also sirens in some places and other observation equipment. It has been a very successful and well-received program.¹⁵⁵

- 4.45 Ms Connell acknowledged the importance of the tower program in terms of beach safety and suggested that it could benefit a Shark Spotters program if were to be implemented:

Obviously the towers, as you heard, the uptake on that every year is 100 per cent in terms of how many they have funded with the \$30,000 that is allowed in funding. It is really important to have elevation not just for shark spotting but also for the surveillance of the beach for swimmers for drownings, which is obviously much higher than shark incidents. It is just really about integrating these things.¹⁵⁶

- 4.46 As the first responders when incidents occur at patrolled beaches, whether it is rescuing a person from drowning or providing assistance to a person injured as a result of a shark incident, the Australian Professional Ocean Lifeguard Association, called for the replacement of the current Observation Tower Grant program:

... current DPI tower grants program (that only provides for grants of no more than \$3000 to be awarded) with a NSW Government program that provides for Coastal Councils to apply for, on a "dollar for dollar" funding basis with an upper limit of \$100,000 per submission available on an annual basis for 10 Coastal Councils each year) to fund lifeguard surveillance towers that comply with current WHS provisions as well as jet-skis (on a provision that funding for a jet ski would be partnered with a tower).¹⁵⁷

SURF PATROLS AND LIFE SAVING

- 4.47 Surf Life Saving New South Wales has more than 100 clubs servicing the State's coastline, responsible for patrolling beaches, encouraging people to swim between the flags and monitoring potential risks to swimmers and surfers. Surf Life Saving has carried out nearly 6,000 rescues and provided nearly first aid in nearly 10,000 instances.¹⁵⁸ Similarly, the Australian Lifeguard Service, a subsidiary

¹⁵⁴ Mr Andrew Kent, Life Saving Manager, Surf Life Saving NSW, Transcript of Evidence, 4 April 2016, p25.

¹⁵⁵ Dr Geoffrey Allan, Deputy Director General, NSW Department of Primary Industries, Transcript of evidence, 4 April 2016, p5.

¹⁵⁶ Ms Sharnie Connell, 4 April 2016, p17.

¹⁵⁷ Submission 63, Australian Professional Ocean Lifeguard Association Inc, p2.

¹⁵⁸ Submission 55, Surf Life Saving New South Wales, p2.

of Surf Life Saving New South Wales, provides contracted lifeguard services at more than 80 locations in New South Wales.¹⁵⁹

- 4.48 As part of its Shark Management Strategy, the Department of Primary Industries is also working in partnership with Surf Life Saving New South Wales and professional lifeguard associations to refine procedures for shark observation and incident response.¹⁶⁰ The role of surf life savers and work between the Department and surf life savers are discussed in more detail in Chapter Six.

COMMITTEE COMMENT

- 4.49 The Committee recognises that there is no single measure that will successfully mitigate the risk of shark attack in all circumstances. A multi-faceted approach is likely to offer the best protection to beachgoers.
- 4.50 The Committee commends the Government's Shark Management Strategy, which provides a coordinated approach to mitigating risk. The Committee recommends that the Department commission an independent evaluation of the Strategy.
- 4.51 Mitigation measures should balance the need to protect beachgoers while at the same time protecting marine life and ecosystems. In respect of this, the Committee was encouraged to hear that the shark detection and deterrent technologies currently being trialled are designed to be eco-friendly and do not pose a significant threat to marine life.
- 4.52 The Committee therefore encourages the Department of Primary Industries to continue trials of new and emerging shark detection and deterrent technologies, with an emphasis on those that do not pose a threat to marine life. The Committee recommends that the Department consider adoption of a shark spotters program where conditions are appropriate.

Recommendation 3

The Committee recommends that the Department of Primary Industries commission an independent evaluation of its Shark Management Strategy no more than two years after commencement of the Strategy.

Recommendation 4

The Committee recommends that the NSW Government consider augmentation of the Observation Tower Grant Program (including but not limited to the provision of extra funding) as a means of achieving better shark and water safety.

Recommendation 5

The Committee recommends that the Department of Primary Industries consider trialling a shark spotters program where local conditions are appropriate.

¹⁵⁹ Mr Brent Manieri, Manager, Australian Lifeguard Service, Transcript of evidence, p22.

¹⁶⁰ NSW Department of Primary Industries, *Shark management: Shark Management Strategy*.

Chapter Five – Use of shark meshing

Introduction

- 5.1 The Committee received a significant number of submissions about the use of shark nets or meshing. The use of shark nets was the subject of strong and sometimes opposing views among Inquiry participants, with some participants opposed to the use of shark nets while others favoured the extension of shark meshing to other beaches, primarily on the North Coast.
- 5.2 The utility of shark nets was not the intended focus of this Inquiry, and the Committee did not conduct a full assessment of the effectiveness of shark meshing. This Chapter details the current NSW Shark Meshing (Bather Protection) Program and concerns about the impact and effectiveness of shark meshing.

NSW Shark Meshing (Bather Protection) Program

- 5.3 Shark nets or meshing was first introduced in NSW in 1937 as a public safety measure to mitigate the risk of human and shark interactions. The NSW Shark Meshing (Bather Protection) Program now includes 51 beaches between Wollongong in the south and Stockton, near Newcastle, in the north.¹⁶¹
- 5.4 The program has had various objectives since its commencement, including but not limited to: reduce the risk of shark attack for surfers and swimmers; cull populations of large aggressive sharks; and deter large sharks from establishing territories close to metropolitan swimming beaches. More recently the widely accepted objective of the meshing program is to reduce the risk of shark attack at major metropolitan beaches.¹⁶²
- 5.5 The program uses specially designed nets along 51 beaches from Wollongong to Newcastle, where the majority of people in NSW swim and surf. The program is divided into five geographical regions; Newcastle (10 beaches), Central Coast (11 beaches), Sydney North (15 beaches), Sydney South (10 beaches) and the Illawarra (five beaches), with one contractor employed per region.¹⁶³
- 5.6 The nets used are 150 metres long, 6 metres deep and have a mesh size of 60 centimetres. They are set below the surface in 10 to 12 metres of water, and within 500 metres of the shore. They are also anchored to the sea bed with only the floats and ropes at the surface.¹⁶⁴

¹⁶¹ Submission 58, NSW Government, p2.

¹⁶² NSW Department of Primary Industries, *Report into the NSW Shark Meshing (Bather Protection) Program*, March 2009, p4.

¹⁶³ NSW Department of Primary Industries, *Report into the NSW Shark Meshing (Bather Protection) Program*, p5.

¹⁶⁴ NSW Department of Primary Industries, *NSW Shark Meshing (Bather Protection) Program*, p14.

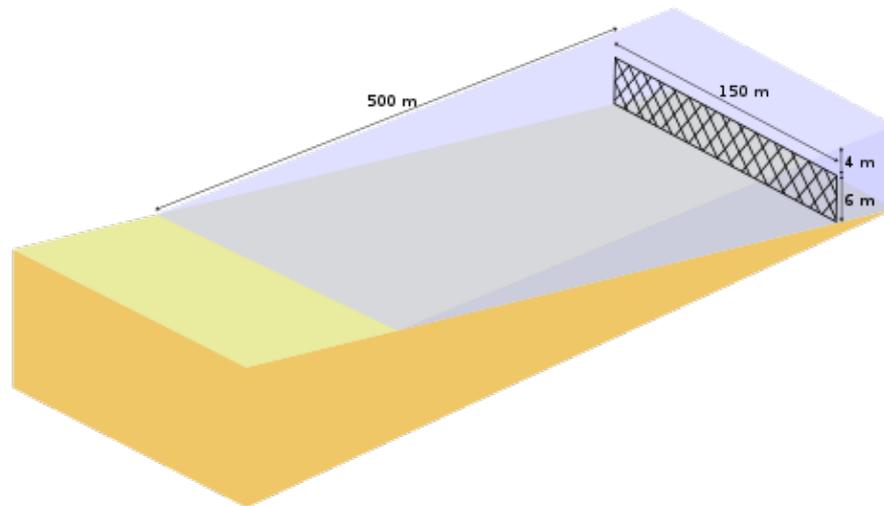


Figure 2: Shark meshing of the type used in NSW

- 5.7 The meshing or nets are designed to mitigate or reduce the risk of a shark encounter rather than as act as a complete barrier across the full length of a beach. Nets are placed in specific locations; usually parallel to a beach with a surf club and that has a patrolled swimming area. Use of the nets is also weather-dependent, as they may not be used when there are strong waves and currents.¹⁶⁵ The nets are used only between 1 September and 30 April each year; this is intended to reduce the risk to whales which migrate during the winter months.¹⁶⁶
- 5.8 The meshing program has now been incorporated into the Government’s Shark Management Strategy. Mr Scott Hansen, Director General, NSW Department of Primary Industries advised the Committee that studies ‘have shown the impact and reduction in risk to humans as a result of meshing in NSW, across Queensland and in Natal, South Africa, where it is in place.’¹⁶⁷

The impact of shark meshing on marine life

- 5.9 The effect of the nets on marine species is well documented. For example, a 2009 report found that between 1950 and 2008, over 16,064 fish and marine mammals had been caught in the nets. The species most commonly caught in the nets were non-dangerous sharks (such as hammerhead, whaler and angel sharks) and stingrays, with smaller numbers of dolphins, turtles, whales and seals.¹⁶⁸
- 5.10 During the 2014-15 meshing season, the Department of Primary Industries recorded 189 marine life interactions with the shark meshing. The interactions were comprised of 44 (23 per cent) with ‘target sharks’ (includes bull, tiger and

¹⁶⁵ NSW Department of Primary Industries, *NSW Shark Meshing (Bather Protection) Program*, Primefact 147, September 2015, Accessed 28 April 2016, http://www.dpi.nsw.gov.au/_data/assets/pdf_file/0003/357438/nsw-shark-meshing-bather-protection-program.pdf

¹⁶⁶ Submission 58, NSW Government, p2.

¹⁶⁷ Mr Scott Hansen, 4 April 2016, p11.

¹⁶⁸ NSW Department of Primary Industries, Report into the NSW Shark Meshing (Bather Protection) Program, p42.

white sharks), and 145 interactions (77 per cent) with non-target marine life. Out of the 189 reported interactions, there were 73 occasions when animals were released alive.¹⁶⁹

5.11 The Department of Primary Industries acknowledges the detrimental environmental impact the meshing program has on a wide variety of marine life. Mr Hansen explained that the Department seeks to balance different priorities in its use of shark nets:

Again, this is one of those mitigation efforts that we have that tries to get the balance right between reducing the risk to those in the water on those 51 beaches versus minimising the environmental impact of those nets.¹⁷⁰

5.12 Beginning with the 2009-10 shark meshing season, the meshing program has operated in accordance with joint management agreements and an associated management plan authorised by the *Fisheries Management Act 1994* and the *Threatened Species Conservation Act 1995*.¹⁷¹

5.13 The Department reviews the meshing program every five years with the aim of adapting or modifying it to minimise its impact in terms of by-catch.¹⁷² This has resulted in measures being taken to reduce the risk to marine life as a result of the deployment of shark meshing. These measures include:

- Acoustic warning devices are fitted to the nets to alert whales and dolphins to their presence and deter them from the nets
- Provisions have been made to remove the nets if there is a high risk of entanglement of whales or dugongs – the public are also notified at the same time
- Setting the nets near the sea bed, in about 10 to 12 metres of water, reduces the potential to harm air breathing animals such as whales, dolphins and turtles
- Not deploying the meshing during the majority of the whale migration season from May to August.¹⁷³

5.14 The shark mesh is also checked at least every 72 hours, weather permitting, for both maintenance purposes and to check if any marine life is caught in the nets. Previously nets were checked every 96 hours. The contractors who maintain the shark meshing are also required to free all marine life caught in the nets where it is safe and practical to do so.¹⁷⁴ Mr Scott Hansen, Director General, Department

¹⁶⁹ NSW Department of Primary Industries, *Shark Meshing (Bather Protection) Program 2014-15 Annual Performance Report*, July 2015, piii.

¹⁷⁰ Mr Scott Hansen, 4 April 2016, p11.

¹⁷¹ NSW Department of Primary Industries, *Shark Meshing (Bather Protection) Program 2014-15 Annual Performance Report*, July 2015, p1.

¹⁷² Mr Scott Hansen, 4 April 2016, p11.

¹⁷³ NSW Department of Primary Industries, *NSW Shark Meshing (Bather Protection) Program*.

¹⁷⁴ NSW Department of Primary Industries, *NSW Shark Meshing (Bather Protection) Program*.

of Primary Industries, explained that the Department initiated the change in order to reduce the by-catch:

... at least every 72 hours because we know that gives us a good opportunity for anything caught in the nets being released alive and successfully. All those mitigation steps have lead us to a point where we believe the balance is right between mitigating the risk to humans with shark interaction and mitigating the risk to the environment. Should we get some of the new technologies providing the outcomes they promise there is a greater chance to reduce the risk to humans and by-catch.¹⁷⁵

- 5.15 Analysis by the Department of Primary Industries, comparing the proportion of animals released alive for the five years before and after the implementation of the joint management agreements, suggests that reducing the checking time to 72 hours has been of some benefit. The number of target sharks, including white sharks released alive have ‘basically doubled’. Hammerhead sharks and dolphins continue to have 100 per cent mortality, while turtle and ray releases remained relatively constant over the reporting period at about 25 per cent and 68 per cent respectively. It should be noted that for many of the animals the number caught is very low, and small changes can be reflected in high percentages.¹⁷⁶

Opposition to shark meshing

- 5.16 The Committee received numerous submissions opposing the use of shark meshing.¹⁷⁷ As already mentioned, the principal reason for opposing the use of nets was the issue of by-catch. For instance, Mr Scott Sanders argued that ‘Both scientific and anecdotal evidence indicate that shark nets have an indiscriminate and calamitous effect upon the ocean's wildlife.’¹⁷⁸
- 5.17 While many Inquiry participants were strongly opposed to shark meshing because of its impact on other marine species, some also objected to the killing of ‘target’ sharks. For example, Ms Hope Nguyen argued that ‘sharks have an inherent right to live their life in their domain without being threatened.’¹⁷⁹
- 5.18 Those Inquiry participants who objected to the use of shark nets cited environmental or ecological reasons for doing so. For instance, the Nature Conservation Council, argued that the use of shark nets was incompatible with the objective of minimising harm to marine life:

The recovery of shark populations should be a primary goal in any management shark management strategy in NSW. The recently announced Shark Management Strategy demonstrates there are non-lethal technologies ... These strategies should be pursued actively.

¹⁷⁵ Mr Scott Hansen, 4 April 2016, p11.

¹⁷⁶ NSW Department of Primary Industries, *Shark Meshing (Bather Protection) Program 2014-15 Annual Performance Report*, July 2015, pp19&22.

¹⁷⁷ For examples, see Submission 6, Sea Shepherd Australia; Submission 11, Clara Wong; Submission 16, Scott Sanders; Submission 17, Gabrielle Ryan; Submission 21, Hope Nguyen; Submission 24, Jon Maxwell; Submission 54, Mikaela Tomasella; Submission 56, Margot Wilson; Submission 60, Manly Environment Centre; Submission 61, Laura Jackson; Submission 80, Nature Conservation Council.

¹⁷⁸ Submission 16, Scott Sanders, p1.

¹⁷⁹ Submission 21, Hope Nguyen, p1.

The current Shark Meshing Program (SMP) in NSW has a significant impact on sharks and other marine animals, killing dozens of sharks and other animals each year, including recognised threatened species ... NCC does not accept that the SMP can meet the core objectives of the Shark Management Strategy which are to “increase protection for bathers” and to “minimise harm to sharks and other animals.”¹⁸⁰

- 5.19 The Nature Conservation Council noted that the grey nurse shark, which is critically endangered, is frequently caught in shark nets.¹⁸¹ Similarly, Sea Shepherd Australia expressed concern that ‘by-catch caught in the nets such as whales, dugongs, turtles, grey nurse sharks and dolphins are fully protected in Australia under Commonwealth and state legislation.’¹⁸²

Support for shark meshing

- 5.20 Conversely, some Inquiry participants from the North Coast supported the introduction of shark nets on local beaches. For example, Ms Vicki Tymmons wrote, ‘my 8 year old even says the Gold Coast & Noosa have nets for their beach swimmers why can't we???’¹⁸³
- 5.21 The Far North Coast Shark Action Group expressed support for the use of shark meshing and drumlines as an interim measure to provide immediate protection for beachgoers on the North Coast. Longer term, the group supports the replacement of the meshing program with proven technologies that both protect beachgoers and minimise their impact on marine life.¹⁸⁴
- 5.22 Similarly, the Yamba Surf Life Saving Club echoed this sentiment, calling for the meshing program to include North Coast beaches. They noted that Queensland’s shark meshing program covers more than 80 beaches between Coolangatta and Cairns, including non-metropolitan beaches and beaches that are not patrolled by lifesavers.¹⁸⁵
- 5.23 Several other submissions also referred to Queensland’s meshing program. Some expressed a preference to cross the border and surf at beaches in Queensland. They believed that Queensland’s meshed beaches offered greater protection in allowing them to pursue the beach and surfing lifestyle they enjoy. It was also suggested that the protection of humans should be the sole priority and that the shark meshing program provided an effective deterrent.¹⁸⁶ For example, one Inquiry participant wrote that, ‘I am planning to move to Currumbin valley simply because Queensland has bathing protection. Two of my friends with kids into surfing, have moved away and planning on selling up here if it's not safe.’¹⁸⁷
- 5.24 Proponents of the shark meshing program pointed to the low number of fatalities on meshed beaches as proof of the success of the program in protecting people

¹⁸⁰ Submission 80, Nature Conservation Council of NSW, p2.

¹⁸¹ Submission 80, p2.

¹⁸² Submission 6, Sea Shepherd Australia, p29.

¹⁸³ Submission 12, Ms Vicki Tymmons, p1.

¹⁸⁴ Submission 5, Far North Coast Shark Action Group, p1.

¹⁸⁵ Submission 8, Yamba Surf Life Saving Club, pp1-2.

¹⁸⁶ For examples, see Submission 1, name suppressed, p1; Submission 4, name suppressed, p4; Submission 7, Mr John Heaton, p3; and Submission 15, Dr Andrew Sharpe, p1.

¹⁸⁷ Submission 1, Mr Joshua Leishman, p1.

from shark incidents and attacks. For instance, Mr Andrew Sharpe wrote that 'The only technology proven statistically to reduce the number of shark attacks/fatalities are nets/meshing and drum line programs.'¹⁸⁸

Do shark nets prevent attacks?

5.25 Inquiry participants who objected to the use of shark nets also questioned whether the nets are actually effective in preventing shark attacks. The Nature Conservation Council, for example, argued that 'it is not clear whether or not the SMP has reduced risk to humans from shark attacks'.¹⁸⁹

5.26 As the nets are only 150 metres long, sharks can swim around and over them. For example, Mr Ken Holloway, National Special Projects Officer, Australian Professional Ocean Lifeguard Association, observed that:

I think that the shark has to be unlucky in some circumstances to be caught in the net because the nets are only 150 to 200 metres long. For example, in Wollongong we have 42 kilometres of coastline and I stand to be corrected but there are only five mesh beaches with nets of 150 to 200 metres long.¹⁹⁰

5.27 To date, there has only been one fatality as a result of a shark attack on a beach where nets are in place. This fatality occurred at Merewether Beach in Newcastle, in 1951.¹⁹¹ However, there have also been a number of serious shark-related incidents at meshed beaches. These include those where people have been bitten, resulting in sometimes serious injury, or had their surf board nudged or bitten by a shark.¹⁹²

5.28 As the Sea Life Trust observed, there have never been any controlled studies to compare outcomes at beaches with and without shark nets.¹⁹³ Moreover, because shark attacks are rare and random and conditions vary at different beaches, such a controlled study is not possible. Mr Hansen explained that the Department of Primary Industries assesses the effectiveness of the nets in terms of risk reduction:

If you have a look at the impact-reducing risk, whilst it is impossible to run a counterfactual that says let us go back and repeat the 80 years without them in place and see what the outcome is, over those 80 years we have had 33 interactions between sharks and humans on those 51 meshed beaches ... You are looking at 33 interactions over 51 beaches that, according to Surf Life Saving NSW, have about 8.5 million people swimming in them per annum, over an 80-year period.¹⁹⁴

5.29 Critics of the shark meshing program pointed to other factors that may influence Sea Shepherd Australia argued that shark nets lull the public 'into a false sense of

¹⁸⁸ Submission 15, Mr Andrew Sharpe, p1.

¹⁸⁹ Submission 80, Nature Conservation Council, p3.

¹⁹⁰ Mr Ken Holloway, National Special Projects Officer, Australian Professional Ocean Lifeguard Association, Transcript of evidence, 26 November 2015, p4.

¹⁹¹ Submission 58, NSW Government, p2.

¹⁹² Mr Scott Hansen, 4 April 2016, p11.

¹⁹³ Submission 79, Sea Life Trust, p9.

¹⁹⁴ Mr Scott Hansen, 4 April 2016, p11.

security,' thus encouraging people to take risks such as swimming further from shore.¹⁹⁵

5.30 The presence of lifeguards at patrolled beaches is also a key factor in preventing shark incidents, particularly fatal incidents. For example, the Marine Ecology Research Centre observed that, 'there is one other method that has resulted in zero fatalities over an extended period of time, one that is often overlooked: surf-lifesaving-patrolled beaches.'¹⁹⁶

5.31 The Sea Life Trust argued that the presence of surf life savers has acted as a greater shark deterrent than the presence of nets, as life savers are able to detect the presence of sharks, quickly evacuate people from the water and close the beach. With the use of jet skis or inflatable dinghies, life guards can also chase sharks away from the beach:

... sharks are much less likely to bite people at a crowded beach – the more people in the water the less likely the shark is to bite people this may be due to noise, or the fact that sharks are opportunistic predators who more likely to bite people and animals that are on their own in the water. (there has never been a shark incident between the flags at a beach).¹⁹⁷

5.32 Improvements in communication and medical treatment may also have played a role in preventing fatalities from shark attacks. The provision of first aid and emergency medical treatment – particularly the use of tourniquets – have reduced instances of fatal blood loss in victims. Improvements in medications, particularly antibiotics, have also reduced the likelihood of post-attack infections, resulting in fewer people succumbing to their injuries.¹⁹⁸

COMMITTEE COMMENT

5.33 The Committee acknowledges the concerns of the North Coast community and supports current efforts to trial and implement shark deterrent technologies that will provide beachgoers with increased protection from sharks.

5.34 The Committee acknowledges the environmental concerns about the current shark meshing program, particularly those related to by-catch and the detrimental impact the program has had on a range of marine life.

5.35 The Committee recognises the work of the Department of Primary Industries to reduce the impact the shark meshing program has on marine life. And encourages the Department through its joint management agreements to continue to examine ways in which the impact of the program can be reduced further.

Recommendation 6

The Committee recommends that the Department of Primary Industries review the Shark Meshing (Bather Protection) Program every three years, to ensure

¹⁹⁵ Submission 6, Sea Shepherd Australia Ltd, p7.

¹⁹⁶ Submission 9, Marine Ecology Research Centre, p4.

¹⁹⁷ Submission 79, Sea Life Trust, pp8-9.

¹⁹⁸ Submission 6. Sea Shepherd Australia Ltd, p6.

that program is better able to adapt and incorporate innovations in technology and best practice.

Recommendation 7

The Committee recommends that, subject to the outcome of current trials, the Department of Primary Industries move toward replacement of current shark meshing with more ecologically sustainable technologies such as the eco-barrier.

Chapter Six – Information strategies

Introduction

6.1 Scientists from the Marine Ecology Research Centre at Southern Cross University outlined four broad options to manage the risk of shark attacks:

1. *We can kill the dangerous animals ...*
2. *We can exclude the animals from areas used by humans ...*
3. *We can avoid the animals ...*
4. *We can make individuals less attractive as potential attack targets.*¹⁹⁹

6.2 As the authors point out, each of these options involves inherent difficulties; some of the difficulties involved in attempts to kill or exclude sharks from areas used by humans were canvassed in the previous chapter. However, the Marine Ecology Research Centre argued that the best option is to avoid sharks:

This option requires that we know where the animals are so we can make an informed decision about the localised risk. This is, by far, the most desirable and practical method of risk reduction from shark attack.²⁰⁰

6.3 The task of knowing where sharks are also involves considerable difficulties. Nonetheless, it is important that what knowledge is available is communicated to beachgoers, to enable them to make informed choices about when and where to enter the water. This Chapter canvasses education strategies as a means of preventing shark attacks.

Department of Primary Industries

6.4 In NSW, the Department of Primary Industries has responsibility for management of the marine environment. Shark mitigation is part of this. At the public hearing on 4 April 2016, Mr Scott Hansen, Director General, Department of Primary Industries explained that the Department takes a multi-faceted approach to shark mitigation:

What can we do to reduce community risk? Part of our strategy is actually investing in new technologies, new tools, that we think actually will end up providing probably the greatest solution – that is, how do you reduce individual risk, whether that be some of the new technologies around sensor disruptors for surfboards or wetsuits? Or how does an individual take their own individual action to reduce their risk not only by behavioural activity – whether it is where you swim, when you swim, how you swim.²⁰¹

6.5 The Department hosts a SharkSmart page on its website, which contains advice for water users about ways to minimise the risk of encountering a shark, as well

¹⁹⁹ Submission 9, Marine Ecology Research Centre, Southern Cross University, pp1-2.

²⁰⁰ Submission 9, p2.

²⁰¹ Mr Scott Hansen, Director General, Department of Primary Industries, Transcript of evidence, 4 April 2016, p5.

as links to pages with information about the different shark species found in NSW waters and the Department's shark management strategy.²⁰² It also includes printable information pamphlets for water users and a portal to order pamphlets in bulk.

6.6 In 2015 the Department also launched a mobile SharkSmart app, which is available from iTunes, GooglePlay and the Department's website. Dr Geoff Allan, Deputy Director General, Department of Primary Industries, explained that the app is 'map-based technology which allows for them to push out notifications and that has been taken up by surf clubs as well'.²⁰³ In 2016 the app was upgraded to include real-time tracking of sharks detected by the Department's VR4G listening stations.²⁰⁴

6.7 Beachgoers face a range of risks, and the risk of shark attack is much lower than the risk of drowning, for example. The Department explained that it works in partnership with other organisations to distribute information and raise awareness about shark issues:

The most successful way has been a partnership approach in most of our awareness and communication activities. So we already have some really successful and well-delivered programs about surf safety in general. How do we tie in with that? How do we best utilise those programs to help get that message out because it is already there, it is already on the ground?²⁰⁵

6.8 The Department also conducted a more targeted campaign on the North Coast, following the spate on shark incidents there. The Department conducted a community forum in Ballina in September 2015, and the Committee received positive feedback about this forum from attendees at its public hearing in Ballina. Mr Hansen explained the work that the Department has done to engage with the local community on the North Coast:

We have put a lot of effort into the North Coast in terms of community engagement and working with chambers of commerce and the community to ensure that as much of the information – in fact, it is a two-way street – about what we are doing is being fed to them. Equally, the information from them about what they want or don't want us to be doing to provide confidence to their visitors, to their communities is being fed back in a two-way street.²⁰⁶

Surf Life Saving clubs

6.9 Surf life saving clubs play a key role in providing information about risks at beaches. Surf Life Saving Australia hosts the Beachsafe website, which provides information about beaches around Australia; this includes information about facilities, weather, surf and fishing as well as risks such as rips and stingers.²⁰⁷

²⁰² See <http://www.dpi.nsw.gov.au/fishing/sharks/sharksmart>, Accessed 28 April 2016.

²⁰³ Dr Geoff Allan, Deputy Director General, Department of Primary Industries, Transcript of evidence, 4 April 2016, p4.

²⁰⁴ Hon Niall Blair MLC, Minister for Primary Industries, 'Shark Smart App upgrade tracks sharks in real-time', 18 March 2016.

²⁰⁵ Mr Scott Hansen, Director General, Department of Primary Industries, Transcript of evidence, 4 April 2016, p5.

²⁰⁶ Dr Geoff Allan, 4 April 2016, p4.

²⁰⁷ See: www.beachsafe.org.au

Surf Life Saving Australia also maintains a presence on Twitter and Facebook, and has a mobile app.

6.10 Surf life saving clubs have a strong presence in coastal areas. Surf Life Saving NSW (SLNSW) has 129 local in NSW and professional lifeguards patrol a further 83 locations around NSW.²⁰⁸ Surf life savers are a visible presence on many popular beaches and as such, are often a first point of contact for beachgoers. Mr Andrew Kent, Life Saving Manager, Surf Life Saving NSW, explained that, 'With the shark stuff we are starting to get into a space where our brand and our organisation is ... if we are seen there the public feel reassured'.²⁰⁹

6.11 SLNSW advised that in October 2015 it distributed nearly 7,500 SharkSmart stickers and flyers, with material being distributed to all local clubs on the North and Mid North Coast.²¹⁰ This was confirmed by representatives at the local level, who advised that they have the SharkSmart education materials and distribute them to beachgoers.²¹¹

6.12 Surf Life Saving also maintains a Coastal Accommodation Network, which provides information about beach safety and potential risks to accommodation providers along the coast. This broadens the reach of SLNSW awareness-raising. Mr Kent explained how the Accommodation Network initiative began:

for the coastal accommodation network, if we started to build up a database of accommodation providers so we can consistently promote safety messaging to these accommodation providers, they would be doing the job for us. And then we can link that in to our dangerous surf warning work which we do with the bureau of meteorology. Every time information comes out from them around dangerous surf warnings we push it to the coastal accommodation network to again drive safety messages to their punters.²¹²

Beach closures

6.13 In its submission, Surfing NSW advised that 'currently, most of the information that surfers rely on are from beach closures due to shark sightings'.²¹³ In most cases, surf life saving clubs have responsibility for closing beaches in the event of a shark sighting. Mr Greg Hackfath, National Field Officer, Australian Professional Lifeguard Association, explained how lifeguards determine whether closing a beach is necessary:

if we have a confirmed shark sighting we will clear the water for a minimum of two hours. If we continue to see more sightings of sharks within that two-hour period then it extends for a further two hours after the last sighting.²¹⁴

²⁰⁸ Mr Brent Manieri, Manager, Australian Lifeguard Service, Transcript of evidence, 4 April 2016, p22.

²⁰⁹ Mr Andrew Kent, Life Saving Manager, Surf Life Saving NSW, Transcript of evidence, 4 April 2016, p24.

²¹⁰ Submission 55, Surf Life Saving NSW, p3.

²¹¹ Mr Alexander Cameron, President, Byron Bay Surf Club, Transcript of evidence, 26 November 2015, p7.

²¹² Mr Andrew Kent, pp26-27.

²¹³ Submission 48, Surfing NSW, p22.

²¹⁴ Mr Greg Hackfath, National Field Officer, Australian Professional Lifeguard Association, Transcript of evidence, 26 November 2015, p1.

- 6.14 Mr Hackfath advised that many shark sightings turn out to be false alarms, as untrained observers can easily mistake a dolphin or other large object under the water for a shark.²¹⁵ Mr Hackfath, explained that increasing awareness of shark risk also generates more sightings, though this does not necessarily indicate increased *risk*:
- We have had a lot of shark sightings but, to tell you the truth, I put that down to hype from the media. So many people are so much more aware of it now. Social media has gone crazy ... we have had reports of grey nurse sharks. There have been so many sightings of sharks at Jetty Beach but most of those sharks have been grey nurse sharks. We all refer to grey nurse sharks as Labradors.²¹⁶
- 6.15 Mr Hackfath emphasised that lifeguards seek to respond only where a shark sighting is confirmed. This information is then communicated online and is available through the SharkSmart app.
- 6.16 However, as Surfing NSW observed, only a small proportion of beaches are patrolled, and most of these are not patrolled at all times.²¹⁷ Mr Hansen explained that, 'when you have a look at the risks that are posed, the biggest risks are quite often those on boards or those swimming on unpatrolled beaches or outside those beaches.'²¹⁸
- 6.17 Surf life savers were acutely aware of the limitations of their services. Most drownings at Australian beaches occur away from patrolled areas.²¹⁹ While beachgoers are encouraged to swim between the red and yellow flags posted by surf life savers, surfing is usually not allowed in these areas. Mr Craig Nowlan, President of the Ballina Lighthouse and Lismore Surf Life Saving Club, remarked that:
- The reality is that we all deal with the red and yellow flags, but there are surfers 200 metres that way and surfers for kilometres the other way. We cannot protect them. What is of concern to the local community is that while we are able to protect a certain area we cannot protect everywhere at present.²²⁰
- 6.18 These limitations point to the importance of educating swimmers and surfers about potential risks, and providing them with information to inform their own decision-making. Mr Mark Windon, Chief Executive Officer, Surfing NSW, acknowledged that in some cases surfers may be aware of risks but decide to enter the water nonetheless:
- Most surfers are risk-takers; it is an extreme sport. Surfing in itself shows they are willing to take that risk. Anyone who has ever surfed ... knows that by going into the

²¹⁵ Mr Greg Hackfath, Transcript of evidence, 26 November 2015, p1.

²¹⁶ Mr Greg Hackfath, Transcript of evidence, 26 November 2015, p8.

²¹⁷ Submission 48, Surfing NSW, p22.

²¹⁸ Mr Scott Hansen, 4 April 2016, p5

²¹⁹ Mr Andrew Kent, Life Saving Manager, Surf Life Saving NSW, Transcript of evidence, 4 April 2016, pp26-27.

²²⁰ Mr Craig Nowlan, President of the Ballina Lighthouse and Lismore Surf Life Saving Club, Transcript of evidence, 26 November 2015, p5.

ocean an interaction with a shark is a real possibility ... I would say surfers in the Ballina region should be taking more responsibility for their actions.²²¹

Co-operation

6.19 While the shark incidents of 2014-2015 had many negative impacts, the positive impact was a closer working relationship between stakeholders. The Committee heard that the working relationship between the Department of Primary Industries, Surf Life Saving NSW, and the Ballina Shire Council is positive and constructive.

6.20 As noted earlier, the Department of Primary Industries has taken a proactive approach in working with the local community on the North Coast to provide information. Both the Ballina council and local surf life savers spoke highly of the Department's work in this regard. For example, Mr John Truman, Group Manager, Civil Services Group, Ballina Shire Council, advised that, 'The access to departmental officers and the access to the Minister's office has been excellent.'²²² On a similar note, Mr Kent advised that the Department had been very helpful to surf life savers:

As time has gone on and the information which has come out from the Department of Primary Industries about shark numbers and their activity, it has been quite reassuring. The constant communication with them has actually been very, very good for the clubs to understand fully what is going on.²²³

6.21 This positive working relationship on the North Coast also provides learnings for future collaboration between the agencies. For example, Mr Kent remarked that the closer relationship between the Department and SLNSW provides a strong foundation for the future of the partnership:

Our position in working with the Department of Primary Industries over the past 12 months has been a great success for both us and the DPI. I think that relationship is now a lot stronger than it ever has been before and in wanting to breed further success in shark mitigation across New South Wales.²²⁴

Linking apps

6.22 The Committee heard that there is scope to improve co-operation between different stakeholders in providing information online. At present there are a number of websites that provide information and advice to swimmers and surfers. These are produced by both government and non-government organisations.

6.23 As previously mentioned, the Department of Primary Industries produces the SharkSmart website and app. The Water Safety website, which provides information about safe swimming, fishing and boating, is produced by the NSW Water Safety Council. Beachsafe is a site and app produced by Surf Life Saving Australia which provides information about local beaches, weather, and possible

²²¹ Mr Mark Windon, Chief Executive Officer, Surfing NSW, Transcript of evidence, 4 April 2016, p52.

²²² Mr John Truman, Group Manager, Civil Services Group, Ballina Shire Council, p22.

²²³ Mr Andrew Kent, Life Saving Manager, Surf Life Saving NSW, Transcript of evidence, 4 April 2016, p28.

²²⁴ Mr Andrew Kent, 4 April 2016, p22.

risks such as rips or rocks, in addition to sharks. Coastalwatch is a website and app that is produced by surfing organisations: it provides surfing news as well as information about weather and swell at beaches.²²⁵ MyBeachInfo is produced by local councils on the North and Mid North Coast of NSW; it provides information about monitored beaches and beach closures in those areas.²²⁶

- 6.24 Some Inquiry participants were critical of the duplication between the different websites, which in some respects provide similar information. For example, Mr Kent observed that the MyBeachInfo website developed by North Coast councils provides essentially the same information as Surf Life Saving Australia's more comprehensive Beachsafe site:

There are councils in the North Coast area that have started using an app or info called MyBeachInfo, which basically drawn information from Beachsafe. What we need to stress is consistency across this public approach. We believe that you should go to Beachsafe for your beach information. ... That is something that Destination NSW and/or councils should be pushing.²²⁷

- 6.25 Mr Kent expressed the view that the Department's SharkSmart website should be the 'number one go-to in terms of public information for shark mitigation'.²²⁸ However, Mr Mark Windon, from Surfing NSW, suggested that surfers may be unlikely to use SharkSmart as a 'go-to' site:

I think the SharkSmart app is good but not many people are going to go to the Department of Primary Industries website to try to find out what is going on. I do not think it has that appeal. I think it probably needs to be linked into something like Coastalwatch or somewhere. Every surfer would be going to Coastalwatch to find out surf conditions. If that app was linked into that you would get far more people going to it and they would be more aware of the fact than just going to a government website—I am not bagging the Government—to try to find something out.²²⁹

- 6.26 However, each of these information sources has a slightly different focus and, presumably, a different target audience. Effective linking between the different websites would maximise their collective reach, but the Committee found that linking between these websites is inconsistent at best. Of the various websites available, SharkSmart has the most comprehensive information about shark activity, yet none of the relevant sites (BeachSafe, CoastalWatch, MyBeachInfo, NSW Water Safety, or Visit NSW) link to it.

COMMITTEE COMMENT

- 6.27 The Committee commends the Department of Primary Industries for its work with the local community on the North Coast about shark risk and implementation of its Shark Management Strategy. The Committee heard that Departmental officers were accessible and informative.

²²⁵ See www.coastalwatch.com.au

²²⁶ See: www.mybeachinfo.com.au

²²⁷ Mr Andrew Kent, 4 April 2016, p29.

²²⁸ Mr Andrew Kent, 4 April 2016, p29.

²²⁹ Mr Mark Windon, Chief Executive Officer, Surfing NSW, Transcript of evidence, 4 April 2016, p53.

- 6.28 Access to information assists beachgoers to make informed decisions about possible risks of encountering a shark. Maximising access to information is therefore a key priority for Government. The Committee commends the work of Surf Life Saving NSW in distributing beach safety information through its Coastal Accommodation Network and recommends that the Department work with Surf Life Saving NSW to ensure that SharkSmart information is distributed through this network.
- 6.29 In relation to availability of information, the Committee was disappointed to find that the option to request SharkSmart brochures on the Department of Primary Industries website did not work when accessed by Committee staff. The Committee is confident that the Department will rectify this technical failure promptly.
- 6.30 The Committee was impressed with the quality of information provided on the Department's website, but considers that a separate website about shark safety may be more effective than a page on the Department's website. The Committee therefore recommends that the Department develop a separate website containing shark information, along the lines of the WA SharkSmart site.
- 6.31 The Committee noted concerns about possible duplication of information about sharks on different websites. The Committee does not have a view as to which website should be the primary source of information for beachgoers and considers that effectiveness of all websites would be maximised by linking to each other.
- 6.32 In this regard, the Committee was disappointed to find that none of the relevant websites such as Visitnsw, Watersafety.nsw.gov.au, BeachSafe.org, CoastalWatch.com, currently link to SharkSmart provided by the Department of Primary Industries on its website. The Committee therefore recommends that the Department of Primary Industries, Destination NSW and the Department of Justice, which hosts the NSW Water Safety website, work to remedy this.

Recommendation 8

The Committee recommends that the Department of Primary Industries develop an independent 'SharkSmart' website, with links to relevant websites including BeachSafe.org, the Department of Primary Industries, and the Water Safety Council.

Recommendation 9

The Committee recommends that the Department of Justice ensure that the NSW Water Safety Council provides a link to the Department of Primary Industries SharkSmart information.

Recommendation 10

The Committee recommends that Destination NSW provide links to Department of Primary Industries SharkSmart information on its Destination NSW and visitNSW websites.

Recommendation 11

The Committee recommends that the Department of Primary Industries work with Surf Life Saving NSW (SLNSW) to distribute SharkSmart information through SLNSW's Coastal Accommodation Network.

Recommendation 12

The Committee recommends that the Department of Primary Industries work with Surf Life Saving NSW, Surfing NSW, and all New South Wales coastal councils to ensure that SharkSmart information is provided on the websites of those organisations.

Chapter Seven – Emerging technologies

- 7.1 In addition to the measures being trialled as part of the Shark Management Strategy there are other new and emerging technologies, including those for personal use, that are currently being investigated. Some of these technologies may have a future as an effective shark deterrent.
- 7.2 These technologies were detailed in the report commissioned by the Department of Primary Industries entitled *Shark Deterrents and Detectors: Review of Bather Protection Technologies* and are summarised in this chapter. The technologies include large scale application of electrical, physical and visual barriers, and a range of personal deterrents.²³⁰

Electrical deterrent barriers

- 7.3 Electric deterrent barriers produce an electric field that can potentially provide protection for all or part of a beach. These barriers are based on the ability of sharks, through the use of specialised receptors, to detect very weak electrical impulses generated by other animals and inanimate objects. The sharks electrical receptors, used for hunting prey, are highly sensitive at short distances and the intense stimulation produced by the barrier could deter a shark from approaching the protected area. Three different types of electrical deterrent barriers are currently under development.

Shark repellent cable

- 7.4 In 2012 the South African Institute of Maritime Safety was commissioned to develop and construct a shark repellent cable, building on the knowledge accumulated during previous attempts to develop such technology. The cable was installed at Glencairn Beach near Cape Town, South Africa, in October 2014. The trial period ended in March 2015. Glencairn Beach is a small beach between two headlands and is exposed to prevailing wind and waves. Its conditions are not directly comparable to those at beaches in NSW.
- 7.5 The cable was successfully deployed and no white sharks were recorded approaching it. However, the ability of the barrier to effectively deter white sharks could not be determined, despite substantial efforts. Further redesign, trialling and monitoring of the shark repellent cable are proposed.

Rubber Guard Electric Fencing (Resen Energy)

- 7.6 Resen Energy is a Danish company working in the field of wave energy technology. It also has expertise in engineering other products including one product called Rubber Guard fencing. This product is used in situations where

²³⁰ NSW Department of Primary Industries, *Shark Deterrents and Detectors: Review of Bather Protection Technologies* October 2015, Accessed 16 May 2015, http://www.dpi.nsw.gov.au/data/assets/pdf_file/0020/621407/cardno-review-of-bather-protection-technologies.pdf

electric fencing that cannot be short circuited by wet vegetation is required. While it is usually used in situations where there is a requirement to keep expensive stock inside or predators like wild dogs, wolves and bears outside, it has been modified for use as a seal deterrent for commercial fishing activities. The manufacturer has indicated it could also be used as a shark barrier.

- 7.7 The Rubber Guard fencing consists of an electric cable on the seabed and a series of flexible vertical rubber fence wires along the cable. The fence uses technology similar to the standard electrical fences. The voltage level is low and is only felt as a slight prickly feeling on humans. The barrier can be powered by a water proof battery or by a combination of photovoltaic power or wave power. While trials of the fencing are planned, it has not yet been tested on sharks or made commercially available.

Shark Repelling System (Aquatek Technology)

- 7.8 The Belgian company Aquatek Technology was formed to focus on developing an electric shark barrier. This followed a series of unprovoked shark incidents in Egypt in 2009. Underwater gates produce an electromagnetic field. Trials have demonstrated proof of concept but more stringent scientific testing has not taken place. The Shark Repelling System will be tested at Reunion Island for the purpose of protecting professional divers who will be in the water for the purpose of constructing a coastal road.

Physical and visual barriers

- 7.9 Physical barriers are intended to separate sharks from beachgoers by physically preventing sharks from accessing a defined area. Some nets may wholly enclose an area. Permanent physical barriers need to be designed to withstand the surf conditions at the location where they are deployed.
- 7.10 Visual barriers are designed to deter sharks from entering an area, but do not physically prevent them from entering. The intent is to create a visual barrier that may reduce the probability of a shark swimming through the barrier.

Bionic Barrier and Aquarius Barrier Nets

- 7.11 The Bionic Barrier and Aquarius Nets are similar to the Eco Shark Barrier but they are designed to withstand more wave energy and drag, and also to reduce costs. In extreme weather the floats are easily removed from the barrier which will allow the frame panels to fold and drop down and rest on the seabed. If part of the barrier is damaged, it can be repaired quickly in situ.

Temporary barrier net

- 7.12 The advantage of using a temporary net is that the need for it to be designed to withstand all surf conditions is eliminated. It does however have the potential for by-catch. The use of temporary barrier nets on NSW beaches could be limited to parts of beaches that are protected in the lee of prevailing winds and waves by rocky headlands.

Bubble curtains

- 7.13 A bubble curtain works by generating air, such as through a compressor, along a submerged perforated hose. As the air escapes through the perforations it rises to the surface creating the effect of a curtain of bubbles. This form of barrier has practical limitations due to being able to maintain a suitably sized barrier in a surf zone. Also, surf zones already have a large number of air bubbles due to ongoing wave turbulence and sharks are often found in surf zones. Therefore, the use of bubble curtains may not be an effective shark deterrent. There are also concerns that the bubbles could have an adverse impact on other marine life.

Sharksafe barrier

- 7.14 The Sharksafe barrier is comprised of two stimuli: grade C9 barium-ferrite permanent magnets and PVC piping which is used to mimic kelp and act as a visual barrier. The piping is anchored to the seafloor and moves with the waves and currents. The use of both the visual and magnetic components in the barrier is to produce two distinct stimuli that sharks can detect.
- 7.15 Trials have shown that the Sharksafe barrier is effective at excluding both white and bull sharks from the area where they are deployed, however, the importance of the barrier's magnetic component is unclear. Consideration also needs to be given to the marine habitat of NSW beaches and whether the barrier would be effective in such habitats.

Personal deterrents

- 7.16 Personal deterrents are designed to protect only the individual who is using the deterrent device. Personal deterrents include electrical, magnetic, chemical, and visual deterrents. It should be noted that individual deterrents are not guaranteed to be wholly effective all of the time.

Electrical

- 7.17 Personal electrical deterrents create an electric field around a person that sharks can detect and prevent them from approaching the person. There are variations with each of the deterrents in terms of the size of the electrical field they generate and the type of field generated. There are also limitations in regard to the extent the electrical deterrents can be miniaturised and still generate an electrical field large enough to potentially deter a shark.

Shark Shield

- 7.18 Shark Shield makes a range of personal deterrents with devices for divers, swimmers and surfers. The deterrents produce an electrical field around the person that can be detected by sharks and potentially prevent the shark from coming closer. For surfers a new model is being developed that has the generating device incorporated into the surfboard's grip pad. This feature will overcome concerns that previous devices, attached to the back of the surfboard, created drag and impacting the surfing performance of those using the device.

- 7.19 Studies have shown the deterrent had an effect on white shark behaviour. The device did not work at repelling or deterring sharks in all situations and for all individual sharks. Additionally, and contrary to the opinion of some members of the surfing community, there is no evidence that the Shark Shield attracts sharks. More research is needed to understand how sharks respond to the device.

Surf Safe

- 7.20 The Surf Safe shark deterrent consists of electronics integrated into the surf board that produce an electric field. In comparison to the Shark Shield, the Surf Safe shark deterrent has not had the same level of testing under controlled experimental conditions.

Magnetic

- 7.21 Personal magnetic deterrents are based on either electropositive metals or permanent magnets, although both can be combined. Unlike electrical deterrents, magnetic deterrents do not require a power source. They have the advantage of being able to be incorporated into devices that are small, lightweight and wearable. The disadvantage is that the fields generated are typically very small in area.
- 7.22 Electropositive metals are metals such as magnesium and rare-earth lanthanide metals that react with sea water when immersed. This reaction generates a small electrical current. This does mean that the metals corrode and need to be replaced on a regular basis. The potential for this technology is not clear as the means by which sharks detect magnetic fields is not fully understood.

Sharkbanz

- 7.23 Sharkbanz use strong magnets in a wrist or ankle band-personal device. The device has limited range and its ability to deter a shark requires further controlled testing.

Chemical

- 7.24 The development of chemical deterrents dates back to the Second World War when the U.S military undertook research in response to the fear servicemen had of sharks. In addition to actually deterring a shark, any chemical deterrent needs to be:

- Non-lethal to sharks and not negatively impact other marine animals
- Synthesised and stored without denaturing for a sufficient period of time
- Be effective in relatively small volumes to allow for practical use.

Consideration of these factors means a number of chemicals that elicit avoidance responses in sharks are unsuitable. Research is now focused on semiochemicals – small organic compounds that transmit chemical messages – rather than those that act as an irritant.

RepelSharks

- 7.25 RepelSharks is a personal chemical deterrent that can be used over an area for a short time before it disperses. The deterrent is available in an aerosol can and is based on decomposing shark tissue. Trials have shown that the deterrent can disperse competitively feeding Caribbean reef sharks. It is possible that for shark species that scavenge on sharks of the same species (conspecifics), the deterrent may act as a feeding stimulant. This potentially includes white and tiger sharks. More testing of the product, especially on white and tiger sharks, needs to be undertaken to determine its suitability as a repellent.

Visual

- 7.26 Scientific understanding of shark vision is still not fully understood but current understanding suggested that it works over a range of up to 100 metres, depending on light and water clarity. It is also believed that sharks lack the ability to see colour and therefore rely on brightness contrast and variation in light intensity to visually distinguish shapes and patterns.
- 7.27 Wetsuit designs have been developed to either 'hide' humans from the view of sharks or to portray humans as 'unpalatable' through patterns based on the surface reflective spectra and the visual acuity of sharks. The use of illumination to disguise a person against the lighter background of the sky is another area idea that shows promise but further research needs to be undertaken.

SAMS Warning and SAMS Cryptic Wetsuits

- 7.28 Shark Attack Mitigation Systems (SAMS) produces two wetsuit patterns – the SAMS warning and the SAMS cryptic. The SAMS warning design is intended to present the wearer as unlike any shark prey, or even as an unpalatable or dangerous food option. The SAMS cryptic is designed to make it difficult for the shark to see the wearer in the water column by using disruptive coloration and shaping. It is also designed to blend in with the background colours. The designs are also used on other products including surfboard stickers and underlays, and swimwear.
- 7.29 The designs are unlikely to make the wearer's silhouette disappear completely as there may be other factors or cues to alert sharks to the presence of the wearer of the wetsuit. Both of the wetsuit designs have not been subjected to rigorous published experimental trials that can support their effectiveness as a deterrent.

COMMITTEE COMMENT

- 7.30 The Committee expresses no preference in regard to which of these technologies offers the best opportunity for the development of a viable shark deterrent. The Committee encourages the Department of Primary Industries to take a methodical and evidence based approach when considering which of these, and any other emerging technologies, are worth further investigation.

Recommendation 13

The Committee recommends that the Department of Primary Industries monitor the outcomes of research and development of shark surveillance and deterrent technologies to identify technologies that could be implemented in New South Wales.

Appendix One – List of Submissions

1	Name Suppressed
2	Portside Marine Pacific
3	Rudy VanDrie
4	Name Suppressed
5	Far North Coast Shark Action Group
6	Sea Shepherd Australia Ltd
7	John Heaton
8	Yamba Surf Lifesaving Club
9	Southern Cross University – Marine Ecology Research Centre
10	Name Suppressed
11	Clara Wong
12	Vicki Tymmons
13	Karl Sprogis
14	Name Suppressed
15	Dr Andrew Sharpe
16	Scott Sanders
17	Gabrielle Ryan
18	William (Bill) Rudd
19	Berenice Roberts
20	Name Suppressed
21	Name Suppressed
22	Oliver Mueller
23	Southern Region SLSA Helicopter Rescue Service
24	Name Suppressed

SHARK MANAGEMENT
LIST OF SUBMISSIONS

25	Confidential
26	Claire Lindsay
27	Confidential
28	Manfred Urs Kock
29	Name Suppressed
30	Humans against Dolphin Captivity and Slaughter
31	Stephen Kambouridis
32	Name Suppressed
33	Brian Hewson
34	OMNA Inc.
35	Anna Dicker
36	Steve Bray
37	North Coast Destination Network
38	Name Suppressed
39	Steven James
40	Alan Baldock
41	Name Suppressed
42	Andrew Nieuwenhof
43	Port Macquarie Longboard Club Inc.
44	Dorsal
45	Peter Cameron
46	No Shark Cull Inc.
47	Cr Irene Doutney
48	Surfing NSW
50	Della Grunwald
51	Warren Hubbard

LEGISLATIVE ASSEMBLY COMMITTEE ON INVESTMENT, INDUSTRY AND REGIONAL
DEVELOPMENT

LIST OF SUBMISSIONS

52	Aquatic Safety Consultants Australia
53	Samantha Lynch
54	Name Suppressed
55	Surf Life Saving NSW
56	Name Suppressed
57	Ballina Shire Council
58	Department of Primary Industries
59	University of Western Australia
60	Manly Environmental Centre
61	Laura Jackson
62	University of New South Wales
63	Australian Professional Ocean Lifeguard Association Inc.
64	Sydney Coastal Councils Group
65	Simon Blears
66	Port Macquarie-Hastings Council
67	Name Suppressed
68	Surveyor Lifeguard Towers
69	Manly Council
70	Australian Aerial Patrol
71	Humane Society International
72	Donny Munro
73	Drew Scerbo
74	Donna Chapman
75	Coffs Harbour City Council
76	Bega Valley Shire Council
77	Ballina Lighthouse & Lismore Surf Life Saving Club Inc.

SHARK MANAGEMENT
LIST OF SUBMISSIONS

78 Shona Macindoes

79 Sea Life Trust

80 Nature Conservation Council of NSW

81 Grandview Apartments Ballina

Appendix Two – Site visit to Taronga Zoo and Sydney Aquarium

On Monday, 26 October 2015 a delegation of the Legislative Committee on Investment, Industry and Regional Development attended site visits to Taronga Zoo and Sea Life Sydney Aquarium as part of its inquiry into the management of sharks in NSW waters. The purpose of the site visit was for the Committee to be briefed on the recent trends in shark attacks, scientific research and findings on shark behaviour, interaction between sharks and humans, and possible alternatives to the current shark meshing (Bather Protection) program.

In attendance were three committee members (the Chair - Mr Kevin Anderson MP, Mr Clayton Barr, and Ms Tamara Smith), and three staff members (Dr Abigail Groves, Mr Kieran Lewis, and Ms Abigail Javier).

Taronga Zoo

The Committee departed from Parliament House at 10:00am via maxi-cab and arrived at Taronga Zoo, Mosman at 10:30am. The Committee was met at the Main Entrance by Ms Madeleine Smitham, Media Relations



Mr Kevin Anderson MP (Chair), Ms Tamara Smith MP, Mr Clayton Barr MP at Taronga Zoo

Officer, who escorted members and staff via Taronga Zoo's skyway to the Lower Entrance gift shop where the Port Jackson sharks were contained.



Mr Anderson, Ms Smith, Kieran Lewis, Mr Barr, Abigail Groves, and Mr Rodd Stapley (Australian Shark File Coordinator)

The Committee was introduced to Mr Rodd Stapley, Coordinator of the Australian Shark Attack File, and Dr Jo Day, Main Shark Researcher, who briefed the Committee on the Zoo's current research and findings undertaken with Port Jackson sharks

in captivity and with data acquired from tag tracking, particularly:

- Migratory patterns (swimming all the way to Tasmania to feed and breed, with males returning to their original areas);
- Hunting and feeding;
- Reproduction (2-4 eggs per year in the wild, and 16 eggs in captivity);
- Anatomy and physiology (note: bites will only crush and leave bruises on humans);
- Social hierarchy.

Mr Stapley briefed the Committee on the recent trends in shark attacks, with an increase of approximately 30 attacks in Australia in a year compared to an average of 12 in previous years, and 1.6 fatalities per year. Mr Stapley and Dr Day inferred that the increase in attacks could be due to an increase in human population and interest in open-water activities, not an increase



Ms Smith and Mr Anderson in front of the Port Jackson Shark enclosure

in shark population. Another factor could be the Great White Shark's protection status – protected since 1999 means the protected juvenile sharks have now reached adulthood,

resulting to a change in diet to bigger marine animals such as seals and whales.



Mr Barr, Ms Smith, Mr Stapley, and Dr Jo Day (Main Shark Researcher)

Dr Day briefed the Committee on the recent Shark Summit that took place in Taronga Zoo on Tuesday, 29 September 2015, and the proposed technology and data collection that were presented at the Summit.



Mr Barr, Ms Smith and Mr Anderson at Sea Life Sydney Aquarium

Sea Life Sydney Aquarium

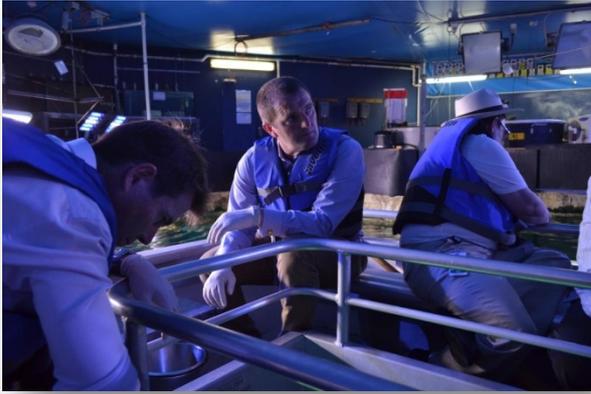
The Committee next travelled to Sea Life Sydney Aquarium, Darling Harbour, arrived at 1:00pm, and met with the Sea Life Trust's Executive Director, Ms Claudette Rechterik, and Sydney Aquarium Curator, Mr Gerhard Beukes. The Committee was given a behind-the-scenes access to the building and

saw how the facility was run:

- Sea Life funding relies mostly on donations and coins that tourists throw in the coin pond.
- Dugongs, sea turtles, and rays are three of their primary species for research.
- Sharks are fed daily, which prevents their primal need to feed off the other fish in the enclosure. Occasionally they would feed on fish that have taken ill.
- Water in the Grey Nurse enclosure comes from the harbour and heated between 23.5 to 24 degrees to maintain the tropical fish. Grey Nurse sharks are known to swim in waters at 19 degrees, but have adapted to higher temperature water in captivity.
- Grey Nurse sharks were caught from the wild and kept there (never to be released), and Lemon sharks were caught from Queensland waters.
- Sydney Aquarium spends an average of \$4k a week on food to feed the marine animals, consisting of fish, squid, and green leafy vegetables.
- Popcorn is used to simulate coral in the enclosures as it is inexpensive. Popcorn is also hollow so fish can swim through them, and non-toxic.



Mr Barr, Ms Smith, Abigail Groves, Mr Gerhard Beukes (Sydney Aquarium Curator), and Mr Anderson



Mr Anderson, Mr Barr and Abigail Groves at the shark feeding glass bottom boat tour

Ms Rechterik and Mr Beukes expressed the importance of sharks, and some negative impacts of shark loss to the environment. For example, an increase in jellyfish and algae affects water quality and habitat for other marine life.

The Committee then participated in a shark feeding glass bottom boat tour from 2:15pm. Mr Anderson and Mr Barr assisted Sydney Aquarium staff members Ben and Aaron to prepare the food prior to the boat tour. During food preparation, Ben reiterated the importance of sharks in maintaining a healthy eco-system. For example, sharks are resilient to most natural diseases, and reef sharks in particular eat sick and injured fish which prevents diseases from spreading.



Mr Anderson, Mr Beukes, Ms Smith, and Ms Claudette Rechterik (Sea Life Executive Director)

Throughout the tour of Sydney Aquarium, the Committee gained valuable insight into sharks, and possible reasons for the increase in shark sightings and attacks:

- There may be an increase in shark sightings, but it does not necessarily indicate an increase in shark growth. More reports of sightings could indicate more people (with the use of technology and social media) are reporting the same shark.
- There is evidence to suggest that shark numbers are decreasing due to fishing nets, shark mesh, and culling.
- Feeding dynamics of sharks may have changed due to climate change – sharks follow the food source, and food source have migrated closer to shore due to change in water temperature.
- Warmer weather has attracted more people into the water.

SITE VISIT TO TARONGA ZOO AND SYDNEY AQUARIUM

- Bull sharks are mostly implicated in attacks on humans.
- Sharks look at contrast and silhouettes, which could be a reason for humans being attacked – mistaking humans for seals.
- There are only estimated 1200-1500 Grey Nurse sharks in the wild.
- There are only estimated 500-1500 Great White sharks in the East Coast of Australia.

Ms Rechterik and Mr Beukes expressed the significance of tagging in the research and understanding of sharks, similar to Mr Stapley's and Dr Day's findings from tracking and data collection. However Mr Beukes stated that tagging has its limitations:

- Tagging cannot document how the tagged animal dies (e.g. killed by a predator, caught in fishing nets, or illness).
- The death of a tagged animal can only be determined if the tag is retrieved, which is not a common occurrence.
- Battery life average is 18 months, although satellite batteries could last up to 10 years.
- Once the tag stops pinging, no more data can be collected.
- It cannot be determined if a tag stops pinging due to battery outage, the tag being damaged, or the tagged animal being eaten. Likewise, if a tag indicates no movement, it cannot be determined if it is due to the tag dislodging from the animal, or if the tagged animal has died and sunk to the bottom of the ocean floor.
- CSIRO has tagged 8 sharks, with 30 sharks tagged overall in Australia. Shark numbers are only an estimation based on extrapolation of data.

The tour of Sea Life Sydney Aquarium concluded at approximately 3:00pm, with members and staff returning to Parliament House.



Mr Barr, Ms Smith and Mr Anderson in front of a sawfish

Alternatives to the current shark meshing program

Delegates from both Taronga Zoo and Sea Life Sydney Aquarium spoke to the Committee about alternatives to the current shark meshing program, which sees

thousands of non-target species killed every year as by-catch.

Mr Stapley and Dr Day spoke about the technologies that were presented in the Shark Summit which would see advancement in research and data collection, such as accelerometers that can acquire data from a tagged shark from 400m away. Dr Day also spoke of a rigid transparent barrier which marine animals would deflect off if they swam to it (similar effects to an aquarium glass).

Ms Rechterik spoke of an eco-shark barrier, similar to the current shark mesh but with larger gaps, allowing other species to swim through. But Ms Rechterik emphasised that the key to shark management is educating the public to take responsibility for their choices about when and where they enter the water.

Appendix Three – List of Witnesses

THURSDAY 26 NOVEMBER 2015, BALLINA SURF CLUB, EAST BALLINA

Witness	Position and Organisation
Ms Belinda Novicky	Executive Officer, North Coast Destination Network
Dr Daniel Bucher	Senior Lecturer of Marine Biology & Fisheries, Marine Ecology Research Centre, School of Environment Science & Engineering, Southern Cross University
Professor Peter Harrison	Centre Director, Marine Ecology Research Centre, School of Environment Science & Engineering, Southern Cross University
Mr Don Munro	Representative, Far North Coast Shark Action Group
Mr Ben Kirby	Representative, Far North Coast Shark Action Group
Mr Nick Mercer	Representative, Far North Coast Shark Action Group
Mr Greg Hackfath	National Field Officer, Australian Professional Ocean Lifeguard Association
Mr Ken Holloway	National Special Projects Officer, Australian Professional Ocean Lifeguard Association
Mr Craig Nolan	President, Ballina Lighthouse & Lismore Surf Life Saving Club
Mr Neil Cameron	President, Byron Bay Surf Club
Ms Natalie Banks	National Shark Campaign Coordinator, Sea Shepherd Australia Ltd
Cr David Wright	Mayor, Ballina Shire Council
Mr John Truman	Group Manager, Civil Services Group, Ballina Shire Council

MONDAY 4 APRIL 2016, MACQUARIE ROOM, PARLIAMENT HOUSE

Witness	Position and Organisation
Mr Scott Hansen	Director, NSW Department of Primary Industries
Mr Geoff Allan	Deputy Director General, Fisheries, NSW Department of Primary Industries
Ms Amy Smoothey	Fisheries Scientist, NSW Department of Primary Industries
Ms Sharnie Connell	Chairperson, No Shark Cull
Mr Andy Kent	Life Saving Manager, Surf Life Saving NSW
Mr Brent Manieri	Manager, Australian Lifeguard Service
Mr Harry Mitchell	General Manager, Australian Aerial Patrol
Mr Duncan Leadbitter	Volunteer, Australian Aerial Patrol
Mr Barry Bruce	Researcher, CSIRO
Mr Mark Windon	Chief Executive Officer, Surfing NSW
Mr Dale Carr	Member, Bite Club
Mr Don Munro	Member, Bite Club (via teleconference)

Appendix Four – Extract from Minutes

MINUTES OF MEETING NO 2

10:00am

Wednesday, 26 August 2015

Room 1043, Parliament House

Members Present

Mr Anderson (Chair), Mr Aplin (Deputy Chair), Mr Henskens, Ms Smith

Officers in Attendance

Bjarne Nordin, Abigail Groves, Abigail Javier

1. Apologies

Apologies were received from Mr Barr, Ms Hay and Mr Rowell

2. Minutes of previous meeting

Resolved, on the motion of Mr Henskens, seconded by Mr Aplin: That the minutes of meeting no. 1 held on 4 June 2015 be confirmed.

3. Briefing from Department of Industry

4. Possible inquiry topics

The Committee deliberated on possible topics for an inquiry.

Resolved, on the motion of Mr Henskens, seconded by Ms Smith: That the Committee conduct an inquiry into the impact of shark attacks on tourism in NSW.

The Chair requested the secretariat to draft terms of reference for adoption by the Committee.

5. Next meeting

The meeting adjourned at 10.35. The next meeting will be at 10.39am on 9 September 2015.

MINUTES OF MEETING NO 3

5.30pm

Wednesday, 26 August 2015

Room 1254, Parliament House

Members Present

Mr Anderson (Chair), Mr Aplin (Deputy Chair), Mr Henskens, Mr Rowell, Mr Barr, Ms Smith

Apologies

Ms Hay

Officers in Attendance

Abigail Groves

1. Minutes of previous meeting

Resolved, on the motion of Mr Henskens: That the minutes of meeting no. 2 held on 26 August 2015 be confirmed.

2. Possible inquiry topics

3. Inquiry into management of sharks in NSW waters

The Chair tabled draft terms of reference for an inquiry into the management of sharks in NSW waters.

Resolved, on the motion of Mr Rowell, seconded by Mr Barr: That the Committee adopt an inquiry into the management of sharks in NSW waters, with the following terms of reference:

That the Committee inquire into and report on the management of sharks and the economic impact of shark attacks on communities in NSW, with particular reference to:

- a) The impact of shark attacks on tourism and related industries;
- b) Changes in shark numbers, behaviour or habitat;
- c) Adequacy of management strategies;
- d) Measures to prevent attacks by sharks, including strategies adopted in other jurisdictions; and
- e) Any other related matters.

Resolved, on the motion of Mr Rowell, seconded by Mr Barr: That the Committee advertise the inquiry with 23 October 2015 as a closing date for submissions, and write to stakeholders inviting them to make submissions.

The Chair asked Members to forward any suggestions regarding stakeholders to the secretariat.

The Chair advised that he would issue a media release regarding the inquiry, and would write to the Premier and the Minister for Primary Industries advising them of the Committee's inquiry.

4. Next meeting

The meeting adjourned at 5.46pm, until 10.30am on 9 September 2015 at Parliament House.

MINUTES OF MEETING NO 4

10.30am

Wednesday, 9 September 2015

Room 1254, Parliament House

Members Present

Mr Anderson (Chair), Mr Aplin (Deputy Chair), Mr Henskens, Mr Rowell, Ms Smith

Apologies

Ms Hay, Mr Barr

Officers in Attendance

Bjarne Nordin, Abigail Groves, Abegail Javier

1. Minutes of previous meeting

Resolved, on the motion of Mr Rowell, seconded by Ms Smith: That the minutes of meeting no. 3 held on 26 August 2015 be confirmed.

2. Inquiry into management of sharks in NSW waters

(i) Letters to stakeholders.

The Chair tabled a list of stakeholders that he will write to inviting submissions to the inquiry. The Committee proposed a number of additions including the Shooters and Fishers Party, the Animal Justice Party, the Australian Veterinary Association and the Animal Welfare League.

(ii) Advertising

The Committee discussed options for advertising the inquiry.

Resolved, on the motion of Mr Aplin: That the Committee advertise the inquiry via Isentia, with particular focus on coastal media outlets.

(iii) Site visit

The Committee discussed options for briefings and visits of inspection.

Resolved, on the motion of Ms Smith, seconded by Mr Rowell: That the Committee conduct a visit to the Sydney Aquarium or similar facility, in mid-October.

3. Adjournment

The meeting adjourned at 10.50am, until a time and date to be determined.

MINUTES OF MEETING NO 5

10.00am

Wednesday, 14 October 2015

Room 1254, Parliament House

Members Present

Mr Anderson (Chair), Mr Aplin (Deputy Chair), Ms Hay, Mr Rowell, Ms Smith

Apologies

Mr Henskens, Mr Barr

Officers in Attendance

Bjarne Nordin, Abigail Groves, Kieran Lewis, Abigail Javier

1. Attendance of observer

Resolved, on the motion of Ms Hay: That the Committee invite Mr Michael Hanson to attend the meeting as an observer.

2. Minutes of previous meeting

Resolved, on the motion of Mr Rowell: That the Committee confirm the minutes of meeting no 4, held on 9 September 2015.

3. Correspondence

The Committee noted the correspondence received from the Hon Stuart Ayres MP, Minister for Tourism, re: Inquiry into management of sharks in NSW waters, dated 8 October 2015, and

requested the secretariat to seek clarification as to which agency is coordinating the government submission to the Committee's inquiry.

4. Inquiry into the impact of shark attacks on tourism

(i) Submissions

Resolved, on the motion of Mr Rowell: That the Committee publish Submissions 1, 2 and 3, and publish Submission no. 4 with identifying information suppressed as per the author's request.

(ii) Site visit

The Committee noted the itinerary for the site visit on Monday 26 October.

(iii) Update from Chair

The Chair provided an update about the progress of the inquiry and tabled a media release from the Hon Niall Blair, Minister for Primary Industries, regarding a workshop in Ballina on 16 October. The Chair did not attend the Shark Summit on 29 September but did visit Port Macquarie and speak with a number of local business operators who expressed their concerns about the unusual number of sharks seen in the area. The Chair has also requested data about visitor numbers in coastal areas from Destination NSW.

Ms Hay advised the Committee about shark issues in the Illawarra region and also suggested contacting Destination Wollongong about visitor numbers there.

5. Adjournment

The meeting adjourned at 10.33am, until 9.40am on 26 October 2015.

MINUTES OF MEETING NO 6

10.14am

Wednesday, 28 October 2015

Room 1254, Parliament House

Members Present

Mr Anderson (Chair), Mr Aplin (Deputy Chair), Ms Hay, Ms Smith, Mr Henskens, Mr Barr

Apologies

Mr Rowell

Officers in Attendance

Bjarne Nordin, Kieran Lewis, Abegail Javier

1. Minutes of previous meeting

Resolved, on the motion of Ms Hay: That the Committee confirms the minutes of meeting no 5, held on 14 October 2015.

2. Inquiry into the impact of shark attacks on tourism

(i) Report from site visit

The Committee conducted a site visit to Taronga Zoo and Sydney Sea Life Aquarium on Monday 26 October to obtain information regarding scientific research into the behaviour and biology of sharks. Mr Barr and Ms Smith provided the Committee with a summary of the information provided to the Committee during the visit.

Resolved, on the motion of Mr Barr: That the Committee writes to thank Taronga Zoo and Sydney Sea Life Aquarium for their hospitality during the Committee's visit of inspection on 26 October 2015.

(ii) Correspondence from Mr Glen Folkard

Resolved, on the motion of Mr Barr: That the Committee notes the correspondence from Mr Glen Folkard.

(iii) Submissions

Resolved, on the motion of Mr Henskens: That the Committee publishes Submissions nos. 5, 6, 7, 8, 9, 11, 12, 13, 15, 16, 17, 18, 19, 22, 23, 26, 28, 30, 31, 33, 34, 35, 36, 37, 39, 40, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 55, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 68, 69, 70, 71, 72, 73, 75, 76; publishes submissions nos. 10, 14, 20, 21, 24, 29, 32, 38, 41, 54, 56, and 67 with identifying information suppressed as per the author's request; and that submissions nos. 25 and 27 remain confidential at the request of the authors.

(iv) Public hearings

The Chair advised that he has contacted the Minister for Trade, Tourism and Major Events, and Minister for Sport, the Hon Stuart Ayres MP, to request that Destination NSW research the impact of shark attack on local economies by investigating its effect on holiday accommodation, cafes, and water activity based businesses. Destination NSW is to provide the Committee with the results of its research by February 2016.

The Committee also discussed the need to visit the North Coast region to obtain firsthand information from local residents and businesses about the impact of shark attacks on the region's local economy.

Resolved, on the motion of Ms Hay: That the Committee holds a public hearing in Byron Bay on Thursday 26 November 2015.

3. Adjournment

The meeting adjourned at 10.35am, until 26 November 2015.

INFORMAL MEETING

10.15am

Thursday 26 November 2015

Ballina Lighthouse Surf Life Saving Club, Ballina

Members Present

Mr Anderson (Chair), Ms Smith,

Officer in Attendance

Abigail Groves

1. Inquiry into management of sharks in NSW waters

The Chair and Ms Smith received advice that Mr Aplin, Mr Henskens and Ms Hay were delayed at Sydney airport. As scheduled witnesses were waiting, they resolved to hear evidence informally.

Mr Anderson opened the meeting. Witnesses and the public were admitted.

Mr Anderson and Ms Smith heard evidence from Ms Belinda Novicky, Executive Officer, North Coast Destination Network.

Ms Novicky withdrew.

Mr Anderson and Ms Smith heard evidence from Dr Daniel Bucher, Senior Lecturer, Marine Biology and Fisheries, and Professor Peter Harrison, Centre Director, Marine Ecology Research Centre, Southern Cross University.

Dr Bucher and Professor Harrison withdrew.

2. Mr Anderson and Ms Smith adjourned at 11.45am.

MINUTES OF MEETING NO 7

11.45am

Thursday 26 November 2015

Ballina Lighthouse Surf Life Saving Club, Ballina

Members Present

Mr Anderson (Chair), Mr Aplin (Deputy Chair), Ms Hay, Ms Smith, Mr Henskens

Apologies

Mr Barr, Mr Rowell

Officers in Attendance

Abigail Groves, James Newton

1. Inquiry into management of sharks in NSW waters

(i) Public hearing

Witnesses and the public were admitted.

Mr Don Munro, Mr Ben Kirby and Mr Nick Mercer from the Far North Coast Shark Action Group affirmed and were examined.

Evidence concluded, the witnesses withdrew.

The Committee adjourned the public hearing at 12.15pm.

The Chair invited members of the gallery to address the Committee. The following people attended and provided advice about the effect of recent shark attacks on the local community and businesses:

- Mr Craig Zerk
- Mr Richard Beckers
- Mr John Watson
- Mr Wayne Webster
- Mr Andrew Nieuwenhof
- Mr Michael Young
- Mr Eoin Johnston
- Mr J. Barry Regan.

The Chair adjourned the public meeting at 2.00pm.

The public hearing resumed at 2.15pm. Witnesses were admitted.

The following witnesses affirmed and were examined:

- Mr Greg Hackfath, National Field Officer, Australian Professional Lifeguards Association
- Mr Ken Holloway, National Special Projects Officer, Australian Professional Lifeguards Association

The following witnesses were sworn and examined:

- Mr Craig Nowlan, President, Ballina Lighthouse & Lismore Surf Life Saving Club
- Mr Neil Cameron, President, Byron Bay Surf Club.

Evidence concluded, the witnesses withdrew.

Ms Natalie Banks, National Shark Campaign Coordinator, Sea Shepherd Australia Ltd, affirmed and was examined.

Evidence concluded, Ms Banks withdrew.

The Chair left the hearing at 3.30pm and Mr Aplin assumed the Chair. The Committee adjourned and resumed proceedings at 3.45pm.

Cr David Wright, Mayor, Ballina Shire Council and affirmed and as examined. Mr John Truman, Group Manager, Civil Services Group, Ballina Shire Council, sworn and examined.

Evidence concluded, the witnesses withdrew.

The Chair closed the public hearing at 4.30pm. The public withdrew.

2. Minutes of previous meeting

Resolved, on the motion of Ms Smith: That the Committee confirm the minutes of meeting no. 6 held on 28 October 2015, noting that the public hearing was held in Ballina rather than Byron Bay.

3. Inquiry into the impact of shark attacks on tourism

(ii) Submissions

Resolved, on the motion of Mr Henskens: that the Committee publish the following submissions on its website:

- Submission 70a – Australian Aerial Patrol
- Submission 70b - Australian Aerial Patrol
- Submission 77 – Ballina Lighthouse and Lismore Surf Life Saving Club
- Submission 78 – Ms Shona Macindoe
- Submission 79 – Sea Life Trust
- Submission 80 – Nature Conservation Council of NSW
- Submission 81 – Grandview Apartments Ballina

(iii) Public hearing (additional items)

Resolved, on the motion of Ms Smith: That the Committee authorise the audio-visual recording, photography and broadcasting of the public hearing held on 26 November 2015 in accordance with the NSW Legislative Assembly's guidelines for coverage of proceedings for parliamentary committees administered by the Legislative Assembly.

Resolved, on the motion of Ms Smith: That the corrected transcript of evidence given at the public hearing held on 26 November be authorised for publication and uploaded on the Committee's website.

Resolved, on the motion of Ms Smith: That witnesses be requested to return answers to questions taken on notice and supplementary questions within 3 weeks of the date on which the questions are sent to the witness.

Resolved, on the motion of Ms Smith: That the Committee publish the documents tendered by Cr Wright and Mr Holloway, respectively.

4. Adjournment

The meeting adjourned at 4.35pm, *sine die*.

MINUTES OF MEETING NO 8

10.02am

Wednesday, 17 February 2016

Room 1043, Parliament House

Members Present

Mr Anderson (Chair), Mr Aplin (Deputy Chair), Ms Hay, Ms Smith, Mr Henskens, Mr Barr, Mr Rowell

Officers in Attendance

Bjarne Nordin, Abigail Groves, Kieran Lewis, Abigail Turingan

1. Minutes of previous meeting

Resolved, on the motion of Mr Aplin: That the Committee confirm the minutes of meeting no. 7 held on 26 November 2015, and note minutes 7a, of the inquorate meeting on 26 November 2015.

2. Inquiry into the impact of shark attacks on tourism

(i) Answers to questions on notice

Resolved, on the motion of Ms Smith: That the Committee publish answers to questions on notice received from Dr Daniel Bucher, Senior Lecturer of Marine Biology & Fisheries, Marine Ecology Research Centre, Southern Cross University and Ms Natalie Banks, National Shark Campaign Coordinator, Sea Shepherd.

(ii) Public hearing – 4 April 2016

The Committee deliberated on possible witnesses for the next public hearing.

Resolved, on the motion of Mr Barr, seconded by Mr Henskens: That the Committee conduct a public hearing on 4 April 2016 and invite the following agencies or individuals to give evidence:

- Department of Primary Industries
- Destination NSW
- Surf Life Saving NSW
- Surf Life Saving Illawarra

- Australian Aerial Patrol
- Surfing NSW
- Bite Club
- Mr Barry Bruce, CSIRO
- No Shark Cull

(iii) Correspondence

The Chair tabled a letter from the Hon Stuart Ayres, Minister for Trade, Tourism and Major Events, regarding the impact of shark attacks upon tourism.

(iv) Shark spotters' summit

Ms Smith advised that there is a shark spotters' summit on 18 March 2016, and she will circulate details.

3. Other business

The Chair advised that he is expecting referral of an inquiry into regional zonal taxation.

4. Adjournment

The meeting adjourned at 10.12 am, until 4 April 2016.

MINUTES OF MEETING NO 9

11.32am

Wednesday, 23 March 2016

Room 1043, Parliament House

Members Present

Mr Anderson (Chair), Mr Aplin (Deputy Chair), Ms Smith, Mr Henskens.

Apologies

An apology was received from Mr Rowell.

Officers in Attendance

Bjarne Nordin, Abigail Groves, Kieran Lewis, Abigail Turingan

1. Minutes of previous meeting

Resolved, on the motion of Mr Henskens: That the minutes of meeting no. 8 held on 17 February 2016 be confirmed.

2. ***

3. Inquiry into the management of sharks in NSW waters

(v) Correspondence

The Committee noted the following correspondence:

- Email from Ms Anna Reed, Policy Advisor, Office of the Hon. Stuart Ayres, Minister for Trade, Tourism and Major Events: re: Destination NSW appearance at public hearing, dated 7 March 2016.

(vi) Public hearing – 4 April 2016

Resolved, on the motion of Mr Aplin, seconded by Ms Smith: That the Committee invite the witnesses as detailed in the program to give evidence at the public hearing on 4 April 2016.

4. Adjournment

The meeting adjourned at 11.45 am, until 9.15 am on 4 April 2016.

MINUTES OF MEETING NO 10

9:15am

Monday 4 April 2016

Macquarie Room, Parliament House

Members Present

Mr Anderson (Chair), Mr Aplin (Deputy Chair), Mr Barr, Mr Henskens.

Apologies

Apologies were received from Ms Hay, Ms Smith and Mr Rowell.

Officers in Attendance

Bjarne Nordin, Abigail Groves, Kieran Lewis, Abigail Turingan

1. Minutes of previous meeting

Resolved, on the motion of Mr Aplin: That the minutes of meeting no. 9 held on 23 March 2016 be confirmed.

2. ***

3. Inquiry into the management of sharks in NSW waters

(i) Media

Resolved, on the motion of Mr Barr: That the Committee authorises the audio-visual recording, photography and broadcasting of the public hearings on 4 April 2016 in accordance with the NSW Legislative Assembly's guidelines for coverage of proceedings for parliamentary committees administered by the Legislative Assembly.

(ii) Transcript of evidence

Resolved, on the motion of Mr Aplin: That the corrected transcripts of evidence given on 4 April 2016 be authorised for publication on the Committee's website.

(iii) Answers to questions on notice

Resolved, on the motion of Mr Henskens: That witnesses be requested to return answers to questions taken on notice and supplementary questions within 2 weeks of the date on which the questions are forwarded to the witness, and that once received, answers to questions on notice be published on the Committee's website.

(iv) Documents tendered during the public hearing

Resolved, on the motion of Mr Barr: That documents tendered during the public hearings be accepted by the Committee and published on the Committee's website.

(v) Public hearing (from 9.30am)

The Chair opened the public hearing at 9.30am. Witnesses and the public were admitted.

Mr Scott Hansen, Director General, NSW Department of Primary Industries, sworn and examined. Mr Geoff Allan, Deputy Director General, Fisheries, and Dr Amy Smoothery, Fisheries Scientist, Department of Primary Industries affirmed and were examined.

Evidence concluded, the witnesses withdrew.

Ms Sharnie Connell, Chairperson, No Shark Cull, affirmed and examined.

Evidence concluded, the witness withdrew.

The Committee adjourned at 11.08am and resumed at 11.20am.

Mr Brent Manieri, Manager, Australian Lifeguard Service and Mr Andy Kent, Life Saving Manager, Surf Life Saving NSW, affirmed and examined.

Evidence concluded, the witnesses withdrew.

Mr Harry Mitchell, General Manager, Australian Aerial Patrol, and Mr Duncan Leadbitter, volunteer, Australian Aerial Patrol, affirmed and examined.

Evidence concluded, the witnesses withdrew.

The Committee adjourned at 12.40pm.

Witnesses and the public withdrew.

The Committee resumed at 1.30pm. Witnesses and the public were admitted.

Mr Barry Bruce, Research Scientist, CSIRO, affirmed and examined. Mr Bruce tendered a document called 'CSIRO White Shark Research'.

Evidence concluded, the witness withdrew.

Mr Mark Windon, Chief Executive Officer, Surfing NSW, affirmed and examined.

Evidence concluded, the witness withdrew.

The Committee adjourned at 3.00pm and resumed at 3.15pm.

Mr Dale Carr, member, Bite Club, sworn and examined. Mr Don Munro, member, Bite Club, attended by teleconference, sworn and examined.

Evidence concluded, the witnesses withdrew.

The Chair closed the public hearing at 4.15pm. The public withdrew.

4. Adjournment

The meeting adjourned at 4.15pm, until 20 June 2016.

MINUTES OF MEETING NO 11

3:00pm

Monday 20 June 2016

Room 1043, Parliament House

Members Present

Mrs Pavey (Chair), Mr Aplin (Deputy Chair), Mr Henskens, Ms Smith.

Apologies

Apologies were received from Mr Barr, Ms Hay and Mr Rowell.

Officers in Attendance

Jason Arditi, Kieran Lewis

1. Committee membership

The Deputy Chair advised the Committee of a change of membership as Mr Anderson was discharged from the Committee on 2 June 2016 following his appointment as Parliamentary Secretary to the Deputy Premier. The Deputy Chair further advised that Mrs Pavey had been appointed to the Committee, also on 2 June 2016.

Resolved, on the motion of Mr Henskens, seconded by Ms Smith: That the Committee thank Mr Anderson for his contribution as Chair.

2. Election of Chair

Resolved, on the motion of Mr Henskens, seconded by Ms Smith: That Mrs Pavey be elected Chair of the Committee. Mrs Pavey then assumed the Chair.

3. ***

4. ***

5. Consideration of the Chair's draft report

The Chair tabled her draft report of the Inquiry into the management of sharks in NSW waters.

The Committee considered Chapter One.

Resolved, on the motion of Mr Aplin, seconded by Ms Smith: That Chapter One be agreed to.

The Committee considered Chapter Two.

Resolved, on the motion of Mr Aplin, seconded by Ms Smith: That the word 'attacks' in two sub-headings in Chapter Two be deleted and replaced with the word 'encounters'.

Resolved, on the motion of Mr Aplin, seconded by Ms Smith: That Chapter Two, as amended, be agreed to.

The Committee considered Chapter Three.

Resolved, on the motion of Ms Smith, seconded by Mr Aplin: That the heading of Chapter Three be amended by deleting the word 'attacks' and replacing it with the word 'encounters'.

Resolved, on the motion of Mr Aplin, seconded by Ms Smith: That Chapter Three, as amended, be agreed to.

The Committee considered Chapter Four.

Resolved, on the motion of Mr Henskens, seconded by Mr Aplin: That the word 'aerial' in paragraph 4.19 be deleted from the first sentence; that the second sentence be deleted and replaced with the words: 'This applies equally to aerial and non-aerial surveillance'; and that the words 'can limit the ability of manner aerial patrols to see sharks,' be deleted.

Resolved, on the motion of Mr Henskens, seconded by Mr Aplin: That the words 'provide additional funds to the Observation Tower Grant Program,' in Recommendation 4 be deleted and replaced with the words 'consider augmentation of the Observation Tower Grant Program (including but not limited to the provision of extra funding) as a means of achieving better shark and water safety.'

Resolved, on the motion of Mr Henskens, seconded by Mr Aplin: That Chapter Four, as amended, be agreed to.

The Committee considered Chapter Five.

Resolved, on the motion of Mr Aplin, seconded by Mr Henskens: That Chapter Five be agreed to.

The Committee considered Chapter Six.

Resolved, on the motion of Mr Aplin, seconded by Mr Henskens: That the words 'North Coast regional' in Recommendation 12 be deleted and replaced with the words 'all New South Wales coastal'.

Resolved, on the motion of Mr Aplin, seconded by Mr Henskens: That Chapter Six, as amended, be agreed to.

The Committee considered Chapter Seven.

Resolved, on the motion of Mr Henskens, seconded by Mr Aplin: That Chapter Seven be agreed to.

Resolved, on the motion of Mr Henskens, seconded by Mr Aplin: That the Chair's report on the management of sharks in New South Wales waters as amended be adopted by the Committee, to be signed by the Chair and presented to the House; that the Chair and the secretariat be permitted to correct stylistic, typographical and grammatical errors; and that, once tabled, the report be published on the Committee's website; and that the Chair issue a press release announcing the tabling of the Committee's report, for dissemination by the Committee secretariat.

6. ***

7. Next meeting

To be confirmed. The meeting adjourned at 4.01pm.